THE
AMERICAN NATURALIST.

VOL. XXII. APRIL, 1888. No. 256.

SIX WEEKS IN SOUTHERN MINDANAO.

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A THREE days' voyage from Puer to Princesa, in the island of Paraqua, by way of Balabac and Sooloo, brought us to the port of Zamboanga, in the southwest part of Mindanao. The harbor is of but little value. It is partly sheltered on the south by the low island of Santa Cruz opposite, but is open to the storms from the southeast. There had been a heavy blow from this direction before we arrived, and a high sea was running; but toward night we got our baggage into a huge dug-out, and were paddled ashore. After some trouble with the customs' officers over our baggage, we were finally, after dark, domiciled in a shaky old fonda, the only hotel the place affords, a liquor and tobacco shop and place for the sale of postage stamps and lottery tickets below, and a lodging place above. We got a promising view the next morning from our window into a yard below, where a dozen pairs of immense bivalve shells (*Tridacna gigas*) lay in the sun. A careful measurement of the largest pair showed three feet and five inches in length and two feet and five inches across the valves. They must have weighed toward two hundred pounds each, or four hundred pounds for a single shell. We found a single valve made a good load for two men. The Spanish naval officers, who seem, like other sea-faring people, to be given to telling large yarns, tell of one off the south coast of Mindanao which has long been noted for its great size, and that the officers of the steam frigate Salamanca once planned to take it home as a present to

Queen Isabella. They steamed down the coast until they found the shell, dropped their strongest hawser around it and put on all steam, but after some time found that instead of raising the shell the steamer was gradually sinking, being drawn under by the immense weight. So they cut the hawser and left the shell in its bed, where they declare it may yet be seen. The smaller species are found in the mud at low tide. Their toothed valves lie gaping apart, and must be traps ready set for any inquisitive monkey who may pass their way. The larger ones are found in deeper water, and there are stories of divers after pearl oysters being caught in their immense jaws and held to their death.

Zamboanga is a town of six or eight thousand inhabitants, nearly all Indian, but of mixed tribes, it having been a convict colony a generation ago, formed from the various islands of the group. The Spanish residents, twenty-five or thirty in number, are gathered with the principal Chinese merchants, at the south end of the town, near the old stone fort and the church. The native town reaches down the coast to the north for a mile and a half, but is concealed in an immense grove of the finest coco palms. The houses are of the ordinary Philippine type, — great baskets of nipa palm leaves, mounted on poles, eight or ten feet above ground. In front of a part of the native town is a village of Moros, Mohammedan natives, who may be the original inhabitants of the place. Their houses are of the same form as those of the Christians, but are poorer, and many of them built over the water, in true Malay style. These people seem to pretty nearly monopolize the business of boat-making and fishing for the town, leaving the Christians to cultivate the soil.

Behind the city is a level country extending for three or four miles to the foot of the hills. Much of it is overflowed and planted to rice. The hills themselves showed patches of sugar cane and other crops, whose cultivation was crawling up their sides, but above and beyond all was still unbroken forest.

We made daily visits to the market, and found the Moro men, marked by their red turbans and tight-fitting drawers, busy selling fish, while their wives were squatted on the ground with little piles — one for a cent — of shell fish spread out before them. Among these were several species of spider shells in abundance, some fine cones and cowries, and great numbers of several species

of bivalves; among them tree oysters, with fresh pieces of mangrove bark sticking to the valves, where they had chopped them loose with their knives.

The woods being too far away to make general collecting easy from the city, after two or three days' stay we embarked in a native outrigger boat, and after three hours of voyage were landed on the grand beach of Ayala, a little town fifteen miles from Zamboango to the north, where I had collected twelve years before. There being no house fitted for our use, we occupied with the officials of the place the tribunal, a large building near the church, and serving for jail, court-house, town-house, and lodging-place for strangers. Coming up to the back side of the town and tribunal were the level rice fields, now flooded with water and just planted or being planted to rice. The woods had been cut back a good deal in the last few years, but we found the rice fields swarming with water birds, and concluded to stop for some weeks. The first trip to the fields produced eight or ten species of waders, and many more followed; sandpipes, snipes, plovers, rails and herons, all in great variety. Many of them were no doubt migrants from the northwest, but several were breeding, and no doubt residents. The population of the place seemed to be hunters by instinct, and as soon as they found that they could get grandes (the big old Spanish copper cents which makes the small change of the islands) for living things, we were besieged by an array of helpers, big and little. Morning, noon and night they were at our door, with shells, turtles, snakes, lizards, birds, and everything else they thought might tempt the coppers out of our pockets. The boys set snares for the birds about the flowers of the trees, and scoured the woods and fields with their bamboo blow guns, and brought in sun birds, forest thrushes, orioles, tailor birds, cuckoos, and even a number of small owls caught napping in the groves of second growth. Several old contraband guns were brought out, and with powder and shot advanced by us, some of the older hunters brought from the woods, back loads of great hornbills, forest pigeons and jungle fowl, with now and then a big-footed mound-builder bird. One little old man, skilled in woodcraft, set a large number of lassoes on the ground, and made us daily visits with his game. The most abundant ground inhabiting mammal seemed to be a large spotted civet cat. One day he brought three of these, and

then a black long-tailed animal as large as a cat, and of the weasel family. After these he brought us jungle fowl, colored like Spanish game fowls, and a few of the large ground pigeons, with a bloody spot in the white breast, called by the Spanish pemhalada, stabbed with a knife. Whenever we could find time from our work of preparing the material purchased we made visits to the forest, and added many species not found by the native hunters.

Two hollow trees inhabited by Galeopithecus were found and chopped down, and from one of these eight were captured and there were others which escaped. They were old females, and young in all stages of growth, so that they would appear to breed the year round. We kept several of them living for some time, and had a chance to observe their habits. One specimen of the curious little Tarsius was brought in. It is probably not rare here, but from its nocturnal habits not readily found. The common monkey, Cynomolgus, was very abundant and tame. We got two species of squirrel, the little *Sciurus philippinensis*, of a dark brown color, not larger than a mouse, but a true tree squirrel, with large bushy tail. Besides this we found a larger red brown one, which does not seem to be described. Besides those mammals mentioned we got a rat and a large shrew, making nine besides the bats. Deer and wild pigs were plenty, but we got none during our stay. Two crocodiles six and a half feet long but apparently adult, were brought in living, tied hand and foot, and were tied to a post in the open space beneath the tribunal. A large monitor, different in species from the Paraqua ones, was abundant, as was also a plant-eating lizard, of about the same size, four or five feet in length, and called by the natives ibit. It is called good food, like the plant-eating iguanos of South America.

Among the lizards was a flying one, *Draco,* abundant on the coco trees, and differing in size and color from those observed in Paraqua. On opening the wing membranes one could not help noticing a likeness to a butterfly, both in shape of wings and in the coloring of nulattix blue with red spots. This case of resemblance must be added to the long list of cases of protective coloring. This peculiar coloring may aid the lizard both in escaping its enemies, the hawks, and in capturing its own food of insects. One evening one of our hunters came dragging in a python over twelve feet long and as thick as a man's arm, which he

had met and shot in the path, and three snakes were brought in of several species, some of them venomous. Among birds we procured three species of horn-fills, all different from those of Paraqua. Among them the great double-crested one, over a yard in length. These were found feeding in the wild fig trees at a height of one hundred and fifty to two hundred feet from the ground, and it tried all the shooting qualities of our guns to bring them down. They made the woods ring with their harsh cries of ca-la-o, from whence they got their native name. We found seven species of kingfishers, among them one apparently unnamed, and the rare spotted *hombroni.* We also found the species of broad-bill Eurylaimus, supposed to be confined to Basilan. It inhabits different heights in the two islands, and a more extended search may prove that the fauna of the two islands does not differ as much as has been supposed. Hawks were abundant and varied, and we procured some nine or ten species varying in size from the great sea eagle, closely allied to our bald headed eagle, and a fish hawk equalling it in size, to the little black hawk with white breast, Microhierax. It is about six inches in length, and one of the smallest of its tribe. The rice fields and adjacent swamps produced six species of rails and eight of herons, with a multitude of other waders.

After three weeks of hard work, interrupted by a few days of fever with two of the party, we returned to Zamboanga with a collection of seven hundred specimens of birds, of some one hundred and fifty species, fifty mammals, seventy-five reptiles, and a few fish and amphibians.

After a visit to the island of Basilan we returned to Zamboanga and went north again, this time to a little bay called El Recodo, or La Culdera, about twelve miles from the city. We had heard that corals were abundant here, and were not disappointed. A gap between the hills into which the sea entered, and then a long, low sand bar running out from one side and bending around, formed a quiet little bay, with deep water in the centre shoaling on every side. Two or three hundred Moros had built low, tumbledown houses along the inner side of the sand bar and over the water, while two or three Chinamen, who had followed them for purposes of trade, had built homes on the inner side of the bay on the Aquala road. After getting settled in one of these houses, we

took boats and paddled over to the bay. The water was very clear, and we could see plainly to a depth of twelve or fifteen feet. Most of the corals seem to grow above this depth, and most of the species here were within a few feet of the surface, and many of them exposed for some time at each tide. The quiet waters seemed to be especially fitted for the more delicate species of Madrepores, Pavonias and Stylasters. Many of these would break of their own weight on being taken from the water. Scattered among the stems of the branching forms were a large number of species of Fungias. Near the shore were whole reefs of most delicate Madrepores and millepores, which would break by dozens at each step as we waded over them, but the broken branches kept on growing, attached themselves to their neighbors, and the reef would be firmer than ever. As soon as the Moros found that we would pay for sea stones, they showed a greater desire for grandes than even the natives of Ayala had done, and there were soon a dozen boats over the bay coral fishing, while the women and girls were wading the reefs to find something that would suit our taste. In this way we got many species which would have escaped us. Even the chief of the village got out his boat, and diving down into about thirty feet of water, brought up specimens of a tree-like Oculina, with stems as thick as the wrist, and very heavy and jet black. He complained of a headache, but on being well paid tried it again next day. We bought and collected corals by the boat-load and spread them upon the sand point to dry and bleach in the sun until we had a ship-load, when we set to work to classify and select such as we could pack. We roughly estimated the species procured at this place at a hundred. Among the novelties was a curious little Fungia not larger than an old copper cent, but with the curious faculty of readily breaking into pieces, when each part would build itself into a disk again. Every storm would serve to multiply them. We found the packing a much greater job than collecting, but the villagers turned in and tore up cocoanut husks, and this, with rice chaff, furnished packing material of good quality. After two weeks of collecting, studying and packing we returned to Zamboanga and took the next steamer for the Central Philippines.

SYNOPSIS OF ROSENBUSCH'S NEW SCHEME FOR THE CLASSIFICATION OF MASSIVE ROCKS.

BY W. S. BAYLEY.

III. The Effusive Rocks.

THE effusive or volcanic rocks are those which flowed out upon a land surface and there solidified. For most of the intrusive rocks there are corresponding effusive ones, as might naturally be expected, but these latter are usually slightly more acid than the former.

The characteristic structure for this group is the porphyritic. The cooling of the effusive rocks takes place in two stages, (1) while the rock mass is still within the depths of the earth—the *intratellurial* period, and (2) after it has flowed out upon the surface—the *effusive* period. During the first stage certain minerals crystallize from the magma. These are idiomorphically developed, and become the porphyritic crystals in a ground mass which is produced by the cooling of the residual magma after it has reached the surface. As the cooling during the effusive period is comparatively rapid, there is a tendency for the ground mass of this group of rocks to approach the glassy condition. When, however, the cooling in the effusive period takes place slowly enough to allow of complete crystallization, a holocrystalline ground mass results and the rock assumes a *holocrystalline-porphyritic* structure.

When the cooling is rapid the ground mass is glassy, and the rock is said to have a *vitrophyric* structure. Between these two extremes are other rocks whose ground mass is composed partly of crystalline minerals and partly of glass. This is the *hypocrystalline-porphyritic* structure.

The ground mass of the holocrystalline-porphyritic rocks may be so developed as to possess either a hypidiomorphic-, a panidiomorphic- or an allotriomorphic-granular structure.

Since the structure of the older members of the effusive rocks

presents features which are different from those presented by the younger ones, it is convenient to separate them into an older and a younger group. The beginning of the Tertiary age seems naturally to be the line of division (in time) between the two groups.

III. A. The Palæovolcanic Effusive Rocks.

The palæovolcanic division of the effusive rocks is distinguished macroscopically by the lithoidal or stony character of the ground mass of its component members.

It includes a continuous series of rocks corresponding in mineralogical composition to the series composing the intrusive class, and, like this latter, is divided into families in accordance with the nature of the principal constituent minerals.

A. THE QUARTZ-PORPHYRIES.

The quartz porphyries are the old effusive equivalents of the granites. By far the larger portion corresponds in mineralogical composition to the granitites, so that no attempt has been made to subdivide them on mineralogical grounds.

They are porphyritically developed—quartz, orthoclase, biotite, sometimes hornblende and augite occurring in porphyritic crystals. The difference of structure observed in their ground mass affords the basis for their further subdivision.

1. Microgranite, in which the ground mass is a very fine panidiomorphic- or hypidiomorphic-granular combination of quartz and orthoclase.
2. Granophyre, in which the ground mass is holocrystalline, but is composed of quartz and orthoclase, developed in such a manner as to mutually penetrate each other.
3. Felsophyre, in which the ground mass is so very fine that its components cannot be recognized under the microscope. When carefully examined it appears as an almost isotropic substance with, however, some indications of structure.
4. Vitrophyre, in which the ground mass is a glass, with or without microlites and devitrification products.
    (A) *pitchstone porphyry* contains porphyritic crystals, recognizable by the naked eye.
    (B) *pitchstone* contains no macroscopic porphyritic crystals.

B. THE QUARTZLESS PORPHYRIES.

The quartzless porphyries are the old effusive equivalents of the syenites. They are porphyritically developed with an alkaline feldspar and one or more of the iron-bearing silicates as porphyritic crystals. Their ground mass is holocrystalline, consisting principally of feldspar and quartz. They are subdivided into:—

1. ORTHOPHYRE, containing a monoclinic alkaline feldspar among the porphyritic crystals.
   (A) *biotite-orthophyre,* containing in addition porphyritic biotite.
   (B) *amphibole-orthophyre,* with amphibole in porphyritic crystals.
   (C) *augite-orthophyre,* with augite as the prominent porphyritic constituent.
2. RHOMBIC-PORPHYRY. This rock is characterized by the rhomboidal shape of its porphyritic feldspars, which belong to the anorthoclase series.
3. KERATOPHYRES, contains a sodium-rich alkaline feldspar, and sometimes quartz, porphyritically developed. Among the bisilicates a malacolitic augite is most prominent. The keratophyres include:—
   (A) *keratophyre,* in which are no porphyritic quartzes.
   (B) *quartz-keratophyre,* in which quartz is porphyritically developed.

C. THE PORPHYRITES.

The porphyrites correspond to the diorites of the intrusive class. They are characterized by the possession of plagioclase and hornblende, together with a dark mica or pyroxene, and sometimes quartz, as their principal components. They are porphyritic, but their ground mass may be either holocrystalline, felsitic or amorphous in character. They are divided in accordance with the nature of the predominating iron-bearing constituent, which occurs along with the plagioclase in porphyritic crystals, into:—

1. MICA-PORPHYRITES, containing biotite as their principal iron-bearing porphyritic constituent, including:—
   (A) *mica-porphyrite,* which contains no quartz among its porphyritic components.

(B) *quartz-mica-porphyrite,* which contains quartz porphyritically developed.

2. HORNBLENDE-PORPHYRITES, containing hornblende as their most important iron-bearing porphyritic ingredient. According as these contain porphyritic quartz crystals or not, they are divided into:—
   (A) *hornblende-porphyrite,* quartz-free.
   (B) *quartz-hornblende-porphyrite,* quartz-bearing.
3. ENSTATITE-PORPHYRITES, containing a rhombic pyroxene as a prominent porphyritic component.

D. THE AUGITE-PORPHYRITES AND MELAPHYRES.

This class corresponds to the gabbros and diabases among the intrusive rocks. Its members consist essentially of plagioclase and augite, and sometimes olivine, idiomorphically developed in a ground mass which may be either holocrystalline, hypocrystalline or glassy. According as the members of this group are olivine-free or olivine-bearing they are divided into:—

1. AUGITE-PORPHYRITES, containing no olivine. This group embraces:—
   (A) *diabase-porphyrite,* possessing a panidiomorphic- or diabasic-granular groundmass of plagioclase and augite.
   (B) *spilite,* which is characterized by its fineness of grain and its lack of porphyritic constituents.
   (C) *augite-porphyrite,* having a fine-grained hypocrystalline ground mass in which are numerous porphyritic crystals of plagioclase and augite. Augite porphyrite includes:—
      (*c* 1) labradorite-porphyrite, in which the porphyritic feldspar is labradorite and the ground mass is composed of a second generation of augite and lath-shaped crystals of plagioclase and a very little glassy base.
      (*c* 2) weiselbergite, in which the ground mass is made up of a second and sometimes a third generation of augite and slender needles of plagioclase, arranged in flow lines in a glassy base (*hyalopilitic* structure).

(c 3) tholeiite, in which the constituents of the ground mass occur in but a single generation, and the structure is hypocrystalline through the existence of a little glass, which is aggregated in small areas between the crystalline components (*intersertal* structure).

(D) *augite-vitrophyrite*, consisting principally of a glassy ground mass in which are a few microlites of plagioclase, augite and magnetite.

1. MELAPHYRES, consisting essentially of plagioclase, augite and olivine. As in the augite porphyrite proper, three types are distinguished :—

(A) *navite*, an olivine-bearing rock corresponding in structure to labrador-porphyrite.

(B) *olivine-weiselbergite*, with the characteristics of weiselbergite.

(C) *olivine-tholeiite*, an olivine-bearing tholeiite.

E. THE PICRITE PORPHYRITES.

The picrite porphyrites correspond to the intrusive peridotites. They are composed of idiomorphic olivine and augite crystals in a ground mass, which consists principally of a glassy base, which by devitrification often becomes weakly doubly refracting.

The picrite-porphyrites are limited in their distribution. They are characterized particularly by the lack of feldspar in porphyritic crystals.

III. B. THE NEOVOLCANIC EFFUSIVE ROCKS.

The neovolcanic rocks occur principally as lavas, on the surface of the earth, as intercalated layers between sedimentaries, as dykes, volcanic necks and bosses. They are characterized by the vitreous appearance of the feldspars.

They are divided according to their mineralogical composition into families corresponding to those of the intrusive and palæovolcanic classes.

A. THE LIPARITES AND PANTELLERITES.

The liparites and pantellerites are composed essentially of an alkaline feldspar and quartz in porphyritic crystals, together with a ground mass which may be either holocrystalline or glassy.

They are separated according to the nature of their porphyritic feldspathic constituents into liparites and pantellerites.

1. Liparites, in which the porphyritic alkaline feldspar is sanidine. These are divided into:—
   - (A) *nevadites*, containing numerous porphyritic crystals and a ground mass whose structure forms the basis for a further subdivision into:—
     - (*a* 1) nevadite, with a holocrystalline ground mass.
     - (*a* 2) felso-nevadite, with a felsitic ground mass.
     - (*a* 3) hyalo-nevadite, with a glassy ground mass.
   - (B) *liparites*, containing few porphyritic crystals, and these few almost exclusively sanidine. These include:—
     - (*b* 1) liparite, with a holocrystalline ground mass.
     - (*b* 2) felso-liparite, with a felsitic ground mass.
   - (C) *hyalo-liparite*, a glass with the composition of liparite, containing microlitic inclusions of sanidine, quartz and the iron-bearing silicates.
2. Pantellerites, in which the porphyritic constituent is anorthoclase.

B. THE TRACHYTES AND QUARTZLESS PANTELLERITES.

This group is characterized by the predominance of an alkaline feldspar among its porphyritic constituents, and its freedom from quartz. In addition to the feldspar there is usually an iron-bearing mineral porphyritically developed.

Their structure, like that of the other effusive rocks, varies widely, but always tends to the porphyritic.

This group is divided into:—

1. Trachytes, in which the porphyritic component is sanidine. The trachytes are next subdivided into:—
   - (A) *trachyte*, with a holocrystalline to hypocrystalline ground mass.
     - (*a* 1) mica-trachyte, with sanidine and biotite as the most prominent porphyritic constituents.
     - (*a* 2) augite-trachyte, in which augite replaces the biotite of (*a* 1).
   - (B) *phonolitic trachytes*, differing from trachyte proper principally in the possession of the characteristic minerals of phonolite, viz., ægirine, acmite and sodalite. They include:—
     - (*b* 1) sodalite-trachyte, which is rich in minerals of the sodalite group.

(*b* 2) acmite trachyte, in which the amphiboloids are acmite, ægerine and arfvedsonite.

(C) *andesitic trachytes*, with a hyalopilitic ground mass tending strongly to a glassy development.

(*c* 1) biotite-hypersthene-trachyte, containing biotite, hypersthene, augite and sanidine in a glassy ground mass.

(*c* 2) the Arso type, in which sanidine and augite are the principal porphyritic minerals, and the ground mass is hypocrystalline.

(D) *hyalo-trachyte*, consisting principally of glass, with the composition of trachyte.

2. QUARTZLESS PANTELLERITES, have anorthoclase and iron-bearing minerals as porphyritic constituents.

C. THE PHONOLITES.

The phonolites embrace the quartz-free combinations of an alkaline feldspar with the minerals of the nepheline and leucite groups, and usually a monoclinic augite.

They include:—

1. PHONOLITES PROPER, containing nepheline and feldspar as the essential porphyritic constituents, as well as the essential components of the ground mass, which is holocrystalline, hypocrystalline, or glassy.

(A) *trachyte-phonolite*, in which sanidine predominates over the nepheline, particularly in the ground mass.

(B) *nephelinite-phonolite*, in which nepheline predominates over the feldspar.

(C) *hyalo-phonolite* or *Phonolite Glass*, a glass with the composition of phonolite, containing microlites of sanidine and augite.

2. LEUCITE-PHONOLITES, containing leucite instead of nepheline among the porphyritic constituents.

3. LEUCITOPHYRES, containing both leucite and nepheline in addition to sanidine.

D. THE DACITES.

The dacites are quartz-bearing plagioclase rocks. They contain, also, one of the iron-bearing minerals of the biotite, amphibole or pyroxene groups.

Their structure varies widely in consequence of the fact that they occur at considerable depths within the earth, and are moreover very sensible to chemical alteration. They are separated, according to their structure, into:—

(A) *holocrystalline dacites*, with many or few porphyritic constituents.
(B) *felsodacites*, with a microfelsitic ground mass.
(C) *andesitic dacites*, with a hyalopilitic ground mass.
(D) *vitrophyric dacites*, or *dacite glasses*, with the composition of dacite holding porphyritic crystals of plagioclase, quartz and the iron-bearing silicates.

E. THE ANDESITES.

The andesites are neovolcanic rocks, composed principally of plagioclase and the iron-bearing silicates of the biotite, amphibole and pyroxene groups, thus corresponding to the porphyrites of the palæovolcanic group, and the diorites, and some of the gabbros of the intrusive class.

They are divided, according to the prevalence of one or the other of the iron-bearing silicates among the porphyritic constituents, into:—

1. MICA-ANDESITES, in which biotite predominates over the other iron-bearing minerals. They are subdivided, according to the structure of their ground mass, into:—
   (A) *holocrystalline mica-andesites.*
   (B) *felsodacitic mica-andesites.*
   (C) *mica-andesites proper.*
   (D) *trachytic mica-andesites.*
   (E) *vitrophyric mica-andesites.*
2. HORNBLENDE-ANDESITES, in which hornblende predominates. These are subdivided as are the mica andesites.
3. AUGITE-ANDESITES, in which a monocline augite is the prevailing iron-bearing porphyritic constituent. Subdivided like the mica-andesites.
4. HYPERSTHENE-ANDESITES, in which a rhombic instead of a monoclinic augite is the prevailing porphyritic constituent. Subdivided like the mica-andesites.
5. HYALOANDESITES, or ANDESITE GLASSES, glasses with the com-

position of andesite, containing a few microlites corresponding to the porphyritic components of the andesite group.

F. THE BASALTS.

The basalts are composed essentially of a plagioclase feldspar and augite, with or without olivine. They differ from the andesites in the predominance of augite over biotite and hornblende, and are thus the equivalents of the diabases.

They possess a wide range of structure, from the hypidiomorphic-granular to the glassy.

They are separated into two great divisions, distinguished by the presence or absence of olivine.

1. OLIVINE-FREE BASALTS, containing plagioclase and augite in a hypocrystalline ground mass.
2. OLIVINE BASALTS, in which olivine is an essential constituent, in addition to plagioclase and augite. Among the olivine basalts are included:—
   (A) *hypersthene basalt*, with an orthorhombic augite as one of the porphyritic constituents.
   (B) *quartz basalt*, with corroded quartzes among the augite, olivine and plagioclase of the first generation.
   (C) *hornblende basalt*, with brown hornblende as a porphyritic ingredient.
4. HYALOBASALTS, or BASALT GLASSES, glasses with the composition of basalt, containing microlites of augite, plagioclase and olivine.

G. THE TEPHRITES AND BASANITES.

The tephrites and basanites contain as essential constituents a basic plagioclase and nepheline or leucite, or both. The former are olivine-free, the latter olivine-bearing.

They differ from the phonolites in the nature of their prevalent feldspar.

Their most common structure is the holocrystalline porphyritic

1. THE TEPHRITES are the olivine-free varieties. They are subdivided, like the phonolites, into:—
   (A) *nepheline-tephrite*, in which nepheline occurs generally as a constituent of the ground mass, but occasionally also in porphyritic crystals.

(B) *leucite-tephrite,* in which leucite replaces the nepheline of the tephrite.

(C) *leucite-nepheline-tephrite,* containing both nepheline and leucite.

2. BASANITES contain olivine as an essential constituent. The olivine is almost always present in porphyritic crystals.

The basanites are subdivided, like the tephrites, into:—

(A) *nepheline-basanites.*

(B) *leucite-basanites.*

(C) *leucite-nepheline-basanites.*

H. THE LEUCITE ROCKS.

The leucite rocks are unique, in that they occur only in the younger effusive series. They contain leucite instead of feldspar as their principal component. With this is always associated augite, and frequently biotite. The occurrence or non-occurrence of olivine serves as a means of separating them into two divisions:—

1. LEUCITITE contains no olivine. Its structure is panidiomorphic- to hypidiomorphic-granular, although it occasionally becomes porphyritic through the development of leucite and augite in two generations.

2. LEUCITE-BASALT contains olivine. Both olivine and augite usually occur in porphyritic crystals, leucite rarely or never. Their structure is porphyritic.

I. THE NEPHELINE ROCKS.

Like the group of the leucite rocks, the present group, which embraces rocks composed principally of nepheline and augite, has no equivalent among the intrusives or the palæovolcanic class.

The prevailing structure is the porphyritic with the iron-bearing silicates and olivine, when it is present, and sometimes nepheline as the porphyritic constituents, while the ground mass is hypocrystalline, and made up in large part of nepheline.

The nepheline rocks are separated into two divisions:—

1. NEPHELINITES, which contain no olivine. These are subdivided, according to structure, into:—

(A) *doleritic nephelinites,* which are coarse hypidiomorphic granular varieties.

(B) *basaltic nephelinites*, usually porphyritic, with less nepheline and more augite than the doleritic varieties.

(C) *phenolitic nephelinites*, porphyritic varieties with nepheline in two generations and a light-colored augite (acmite) only in the ground mass.

(D) *camptonitic nephelinites*, porphyritic varieties with a base composed principally of nepheline or a glass with the composition of this mineral, and numerous porphyritic crystals of augite and hornblende, sometimes in two generations.

2. NEPHELINE-BASALTS, olivine-bearing. The prevailing types are those corresponding to the doleritic and basaltic nephelinites.

J. THE MELILITE ROCKS.

Melilite rocks are also confined to the neovolcanic class. They have no representatives among either of the other classes. They consist essentially of melilite, olivine and augite.

Their normal structure is the holocrystalline porphyritic, in which olivine, augite and biotite, and sometimes melilite, occur in two generations, although the last-named mineral is more commonly found only in the groundmass.

The separation of the group into two varieties:—

(A) *melilite-basalts*, and

(B) *alnöites*, rests almost entirely upon geological grounds. The alnöites, however, are much richer in augite than the melilite basalts, and also contain more biotite.

K. THE LIMBURGITES AND AUGITITES.

This group includes rocks composed in larger part of pyroxene, with or without olivine. They usually contain also a little plagioclase and hornblende.

Their normal structure is the hypocrystalline porphyritic, though sometimes they become completely amorphous through the absence of porphyritic constituents.

They are divided into:—

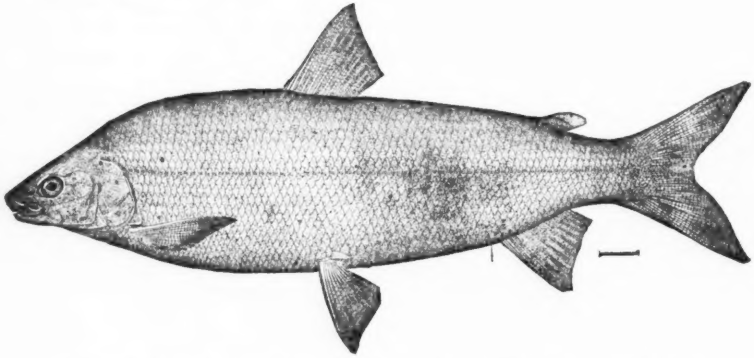
1. LIMBURGITES, which are olivine-bearing, and
2. AUGITITES, which are olivine-free.

Colby University, Waterville, Me.

DISTRIBUTION AND SOME CHARACTERS OF THE SALMONIDÆ.[1]

BY TARLETON H. BEAN.

THE family of Salmonidæ—embracing the white fishes, the salmons, and the trouts—is one of the most important of the temperate and arctic regions of the world. For the purposes of this paper, I exclude all of Argentininæ, which have very little value, if we except the capelin, the eulachon, and the smelts. I omit, also, the graylings (Thymallus), which are set apart by Dr. Gill as representing a distinct family, Thymallidæ. The genera included in my essay are the following: Coregonus, Stenodus, Oncorhynchus, Salmo, and Salvelinus.

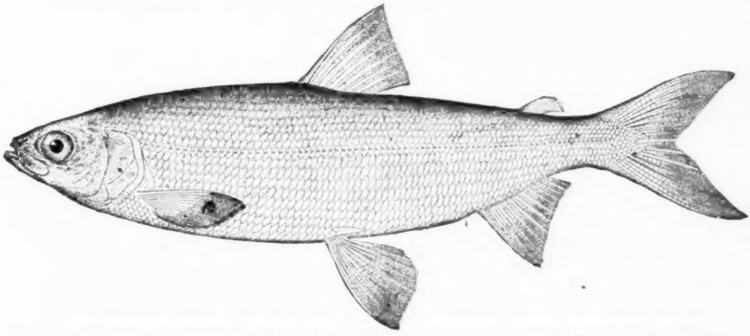


Common White-fish (*Coregonus clupeiformis*). Ecorse, Michigan. About ¼ natural length.

There are about forty nominal species of white fishes (Coregonus), of which twelve are North American, and are readily distinguished by good characters. Several species are found in Great Britain; the rest are distributed over the North of Europe and Asia, scarcely extending as far southward as 46° North latitude. The largest

[1] Read before the Biological Society of Washington, Feb. 25, 1888.

species exist in Russia, Siberia, Alaska, and our great lakes. The relation between the Siberian and Alaskan forms has never been fully worked out; but species which have been considered identical from the two sides of Behring Strait proved upon examination to be distinct. The species of Coregonus are anadromous only in the far North. One species, which is not represented in America—*Coregonus oxyrhynchus*—leads an existence which is indifferently marine or fresh-water. In the United States, the most southerly species—and one of the smallest, *Coregonus williamsoni*—is found as far south as the Sevier River, in Utah, in about 38° North latitude, or eight degrees farther south than any species in the Old World. Three species extend as far north as Point Barrow—laurettæ, nelsoni, and richardsoni, the first and the last of these being valuable food species. *Coregonus pusillus* probably reaches Point Barrow also, as I have seen it in Hotham Inlet.

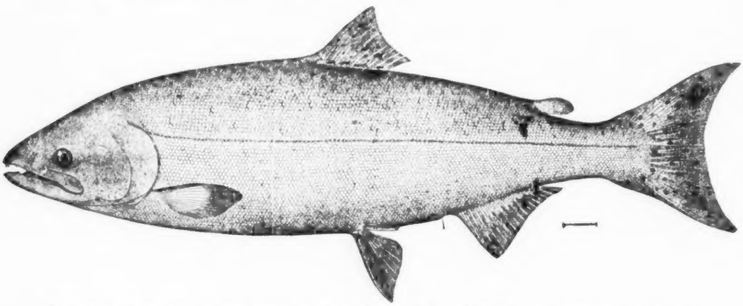


Vendace (*Coregonus albula*). Baland Lake, Prussia. About ⅜ natural length. Introduced into the United States.

The most easterly of our white fishes are labradoricus, quadrilateralis, and artedi, all of which are small, and the last varies so much from the type to the eastward as to make its separation probable. The largest species are clupeiformis and richardsoni. Clupeiformis is the common white fish of the great lakes. It does not extend very far into British America, and is replaced northwestward in Alaska and the arctic portion of British America by the *Coregonus richardsoni* (kennicotti of late works).

Stenodus is believed to be nearly related to Coregonus; but its characters have not been fully studied. Its species reach a larger size than is usual in Coregonus. Only two are known with cer-

tainty, and these are closely similar. One of them is found in Alaska and the other in Russia. Other species are said to ascend some Siberian rivers from the Arctic Ocean. I have compared a specimen from the Volga with our Alaskan "inconnu," and find their similarity very striking. They agree substantially in number of fin-rays and rows of scales; but the first appears to have several more rows above the lateral line than the other.

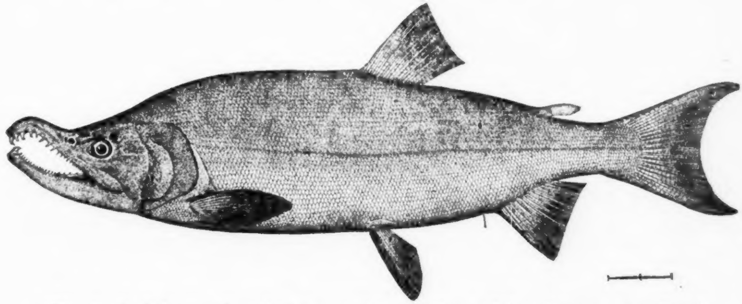


Quinnat Salmon (*Oncorhynchus chouicha*). Columbia River, Oregon. About ⅛ natural length.

The genus of Pacific salmons (Oncorhynchus) which is very closely related to Salmo, is represented by five species, all of which are more or less black-spotted, especially while sojourning in streams. They ascend the rivers falling into the North Pacific in Asia and North America. The distribution in Asia is incompletely known. All of the species have been certainly identified from Kamschatka. *O. gorbuscha*, the little humpback salmon, extends farthest north, having been found in the Colville River in Alaska and ranging southward only to Oregon. The dog-salmon (*O. keta*) has been taken in the Kowak River, Alaska, and southward to California. The blueback or red fish, *O. nerka*, extends northward at least to the Yukon and southward to the Columbia. Chouicha, the king or quinnat salmon, is known from the Ventura River, in California, to the Yukon, in Alaska. *O. kisutch*, the silver salmon, ranges from San Francisco, probably, to the Yukon. The most northerly species, gorbuscha, is the smallest and least valuable. The only good character which may be depended upon for distinguishing Oncorhynchus from Salmo is its numerous rays in the anal fin.

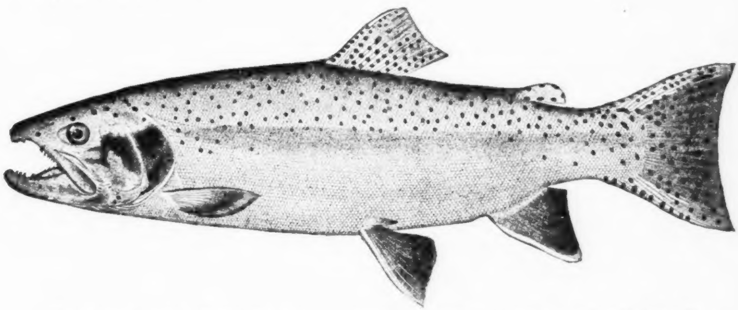
Salmo inhabits Great Britain and the Continent of Europe; it sends a representative into Africa; it is more or less represented in

Asia, and is well-established in North America. The Asiatic species are, for the most part, little known. Most of the species are non-migratory and inhabit fresh-water lakes and streams.



Blue-back Salmon (*Oncorhynchus nerka*). Wallowa Lake, Oregon. $\frac{1}{4}$ natural length. "Hook-jawed" male.

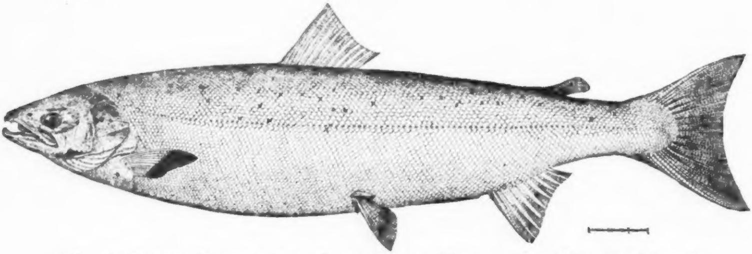
In the Eastern Continent, the southern limit of Salmo is in about 37° North latitude. A single doubtful species—*S. macrostigma* of Duméril, which may be identical with the common fario—was found abundant in the Oued-al-Abaïch, forty kilometres west of the town of Collo, in Northern Algeria. This species was founded on young specimens having about eight parr marks. The vomerines are figured as in two rows of about seven teeth each, just as in fario. The scales in British Museum examples are: 27, 122, 34; pyloric cæca, 28 to 31; vertebræ, 57. Their resemblance to young fario was observed by Dr. Günther.



Rainbow Trout (*Salmo irideus*). Verona, Missouri. About $\frac{3}{14}$ natural length. Introduced by U. S. Fish Commission.

In California one species, *Salmo irideus*, is found as far south as the Mexican line. But the most southerly of all our species and of

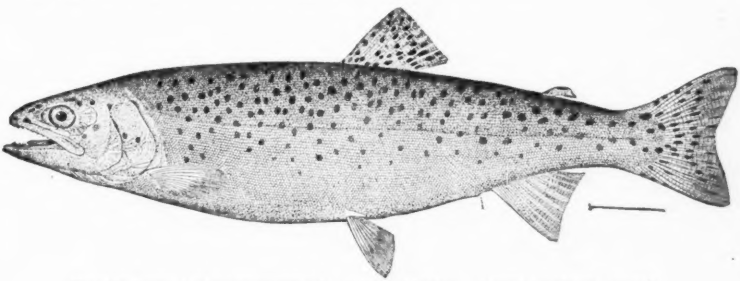
all the known Salmonoids of the world is mentioned by Professor E. D. Cope, in the AMERICAN NATURALIST, August, 1886, page 735. He has young black-spotted trout obtained by Professor Lupton from streams of the Sierra Madre, Mexico, at an elevation between eight and nine thousand feet, in the southern part of Chihuahua, near the boundaries of Durango and Cinaloa. They have teeth on the basihyals, and resemble, in other respects, *Salom purpuratus* of the Great Basin.



Atlantic Salmon (*Salmo salar*). Susquehanna River. About ⅛ natural length. Introduced by U. S. Fish Commission.

Students of the Salmonidæ in Europe frequently refer all of the numerous nominal species of Salmo to three principal forms—salar, trutta, and fario. The first two represent the genus Salmo, characterized by anadromous habits and imperfect development of the vomerine teeth. The third is placed in the sub-genus Fario, which has persistent, well-developed vomerines in one or two series, and, in its habits is non-migratory. One noticeable feature about the European species of Salmo is that they are nearly all large-scaled seldom having more than 125 scales in a longitudinal series. The only exception to this rule is *Salmo microlepis* of Hungary, which has 135 to 140 rows of scales. North America and Asia have at least one species of Salmo in common,—a small-scaled species,—*S. purpuratus*. This is the most widely-distributed and the most variable of our species. Northward, we have no certain knowledge of it beyond Unalaska; southward, it ranges to Mount Shasta, in California. Its distribution is extended by the varieties, henshawi, pleuriticus, and stomias. *Salmo henshawi* occurs in Tahoe Lake, California, Pyramid Lake, Nevada, and in streams of the Sierra Nevada. *Salmo pleuriticus* occupies the Utah Basin and the headwaters of the Rio Grande. The trout found in Mexico may be closely similar to this, as it seems to inhabit affluents of the Rio

Grande. *Salmo stomias* dwells in the Upper Missouri and in the Kansas River. It is the most easterly of all our black-spotted trout. *Salmo purpuratus* has hyoid teeth, and, in all its varieties, bears a crimson blotch on the under surface of the head, which is characteristic of the species. It has, also, small scales, which diminish progressively in henshawi, pleuriticus, and stomias.



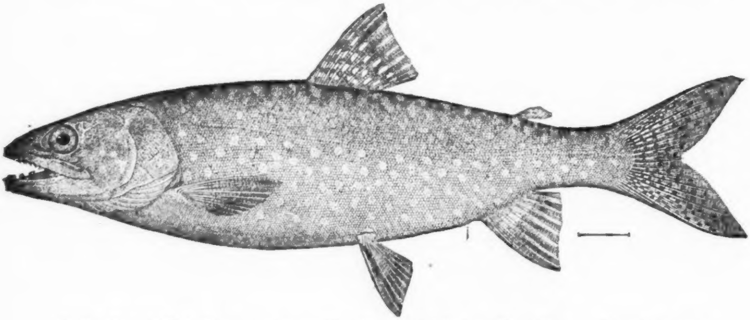
Clark's Trout (*Salmo purpuratus*). Sitka, Alaska. About ⅓ natural length.

The eastern limit of our species of Fario, as already stated, is reached by the *Salmo stomias.* East of the Mississippi Valley no species of this genus are found native. The distribution of the species of Fario would seem to indicate that they originated in Asia or the Continent of Europe and migrated both to the eastward and the westward. In America the eastward distribution was checked by the plains of the middle region, which do not furnish conditions favorable to salmon-life; and the ocean barrier on the east prevented the spread of Fario into our Atlantic streams. If these black-spotted species were better adapted for Arctic life, their range might have been similar to that of the red-spotted charr.

Before leaving the black-spotted salmonoids, it may be well to add something concerning the singular Huchen or Rothfisch of the Danube. The genus Hucho has very small scales, pyloric cæca very numerous, gill-rakers short and few, vertebræ sixty-eight, a forked caudal, a remarkably broad maxilla, with a well-developed supple mental bone, a pike-like skull, and peculiar dentition; the jaw are armed with strong teeth; the vomerines and palatines are strong and in a continuous series—the palatine portion very long; tongue with teeth; hyoid toothless. The range of the single known specie appears to be very restricted.

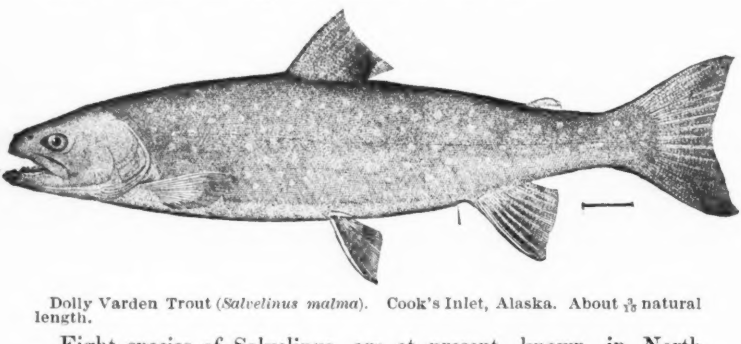
The genus Cristivomer, which appears to be only a section of Sal-

velinus, has two species, the lake-trout and the siscowet—namaycush and siscowet. The lake-trout is one of the largest and most widely



Lake Trout (*Salvelinus namaycush*). Raquette Lake, New York. About $\frac{1}{10}$ natural length.

diffused of the Salmonidæ. Richardson had it from Boothia Felix, in North latitude 70°. Turner found it very common in Labrador. It is very abundant in lakes of New England and New York and in the great lakes. We have obtained it recently from Henry Lake, in Idaho. This lake empties into Snake River, a tributary of the Columbia. We have also a head and fins of the species from Camin Lake, in British Columbia. Richardson records it from Great Bear Lake. Townsend and Stoney obtained specimens in the Kowak River, a stream flowing into Hotham Inlet, Alaska.

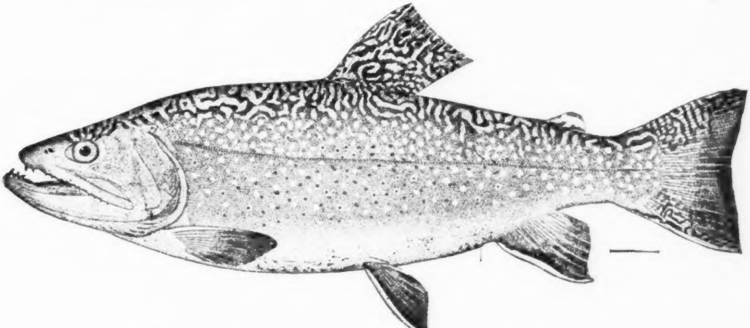


Dolly Varden Trout (*Salvelinus malma*). Cook's Inlet, Alaska. About $\frac{1}{10}$ natural length.

Eight species of Salvelinus are at present known in North America, only one of which, malma, we share with Asia. Seven of the species occur in eastern North America, and, with one or two exceptions, they are very closely related to the common saïbling of

Europe, *S. alpinus*. All of our species except fontinalis—the common brook trout—belong to the group having hyoid teeth. The largest species on both sides of our continent extend far to the northward: malma to the Colville River, in Alaska; stagnalis and rossi to Boothia Felix and Greenland. As a rule, all of our red-spotted charr with hyoid teeth have the dorsal and caudal fins without bands, while in the common brook trout—which is usually without hyoid teeth—these fins are always banded and mottled. The small charr of Monadnock Lake, in New Hampshire, *S. agassizi*, belongs to the group with hyoid teeth and forked tail. It has the dorsal and caudal banded, but the body has no mottlings, such as are found in fontinalis.

The character of the absence of hyoids in fontinalis is not to be absolutely depended upon in classification. About ten per cent. of the seventy-three examples obtained by Mr. L. M. Turner in Labrador have hyoids feebly developed, there being in no case more than three of these teeth present. From Castleton, New York, we have a specimen with hyoids; and in a brook trout from Woods Holl, Massachusetts, three hyoid teeth exist. It would seem that these, exceptional occurrences of hyoids are most pronounced and frequent in the northern portion of the habitat of fontinalis, the range of which species is now known to extend from Labrador to North Carolina, and, perhaps, Georgia.



Brook Trout (*Salvelinus fontinalis*). New York Market. ¾ natural length.

The most northerly species of Salvelinus recorded is the arcturus of Günther, a species which is said to lack red spots. If the current illustrations be correct, this is the least highly-ornamented of the

genus. No specimens longer than twelve inches are known, and hese are mature. They were obtained in Victoria Lake, North latitude 82° 34′, and in fresh-water pools of Floeberg Beach (82° 28′). This species is the most northern salmonoid known.

Before leaving this subject it may not be amiss to recall the fact that the origin of the Salmonidæ is obscure. No fossils of true Salmonidæ are known, except one genus, which is based upon the cranial bones only. This genus, Rhabdofario of Cope, is from Lake Idaho, a late tertiary lake in Eastern Oregon and Western and Southern Idaho. The following account of the *Rhabdofario lacustris* is from Professor Cope's paper in *Proceedings American Philosophical Society*, 1870:—

"A species with a head as large as that of the *Salmo salar*. The genus is nearly allied to Salmo. With no other portions of the animal than the cranial bones, the only difference I discover is in the form of the maxillary bones, which are sub-cylindric or rod-like, instead of flat or laminiform, as in Salmo. At the extremity, though flat, they are still narrow; and I do not find surface of attachment for the supernumerary bone of Salmo. Teeth on the maxillary and mandibular arches large, numerous; teeth on the vomer, glossohyal, and palatine bones also well developed. Muzzle and mandible subequal. Maxillary . . . . bearing reduced teeth near its extremity."

The pertinence of Rhabdofario to the Salmonidæ is, perhaps, open to doubt, on account of the shape of the maxilla and the probable absence of a supplemental bone.

OBSERVATIONS ON AMPHIUMA AND ITS YOUNG.

BY O. P. HAY, M.D.[1]

THE waters of our Southern States are inhabited by certain elongated air-breathing animals, which are popularly known and feared under the name of Congo Snakes; although they in reality belong not among the serpents, but to the class of Amphibians. Of these animals, naturalists have up to near the present time recognized two species, and even two distinct genera, Amphiuma and Muraenopsis, the two forms being distinguished by the possession respectively of two and three digits to each of their very feebly developed legs. The occasional finding of specimens with two toes on some of the feet, and three on the others, has cast doubt on the generic value of this character, and made it quite certain that both belong to the same genus.[2] As there are few or no other differences of importance between the two supposed species, it is now thought by some batrachologists that there is after all but a single species; and this is the view at present held, I believe, by Professor E. D. Cope, the best American authority on such matters.[3] *Amphiuma* (*Murænopsis*) *tridactylum* is, in this case, to be regarded as merely a variety of *A. means*.

Of the habits, especially the breeding habits, of the lower Amphibia, in species of which North America is rich beyond all other countries, little appears to have been discovered. Siren, Necturus, Amphiuma and Cryptobranchus are all strictly aquatic, or nearly so, in their manner of life. With a few remarkable exceptions, our Amphibia, whether affecting a terrestrial or an aquatic habit in adult life, lay their eggs in the water; and the young, for a time after hatching, live in that element, and breathe by means of gills. In cases where the young of a species have not been discovered, it has been assumed that they possess gills, which are afterward absorbed.

[1] Published by permission of Dr. John C. Branner, Director of the Arkansas Geological Survey.

[2] Ryder, Proc. Phil. Acad., 1879, p. 14.

[3] Proceedings Amer. Philosoph. Soc. 1886, p. 526.

This assumption has been made in the case of Amphiuma. On general principles, Cuvier concluded that in early life it has gills. This was uncertain, and has been denied. Later authorities, among them Professor Huxley, state that its gills are "caducous," but that this conclusion rests on any one's observations I am not aware. Of its other habits little seems to be known. Holbrook, in his great work on North American Reptiles, thus speaks of the species:—

"*Amphiuma means* lives in muddy water or in mud. Harlan says they have been found at Pensacola three feet or more deep in mud of the consistency of mortar, in which they burrow like earthworms. They inhabit the ditches of our rice-fields, and feed on small fish and various fresh-water shells, as Unio, etc.; beetles and other insects have also been found in their stomachs. Sometimes, like eels, they are found on dry land, but for what purpose they approach it is unknown" (N. A. Herp., 1842, v., 91).

"I am unacquainted with the habits of the *Amphiuma tridactylum*, but suppose these to be similar to those of the *Amphiuma means*" (Ibid., 93).

At the close of August, 1887, I spent a few days in Little Rock, Ark., in the employ of Dr. Branner, of the Arkansas Geological Survey. On September 1st I visited a cypress swamp in the vicinity of the city for the purpose of collecting some reptiles. During the severe summer drought this swamp had been almost completely dried up, and there was little chance to get anything except by turning over pieces of fallen timber. Beneath a log of considerable size I found, to my surprise, a large animal coiled up, which by its smooth glistening skin I immediately saw could not be a snake; but, having never before seen a living Amphiuma, it took me some time to realize that I had before me one of these animals. After making due preparations to prevent its escape, I gave the animal a push with a stout stick, and then, no attempt at retreat being made, I lifted it out of the slight depression in which it was lying and let it straighten itself out. Meanwhile I had observed, lying in the midst of the coils, a mass of moist-looking matter, nearly as large as one's fist. Picking this up, I discovered it to be a mass of eggs. This was put into a jar of alcohol, and immediately the young within the egg could be seen writhing about, thus showing that they were in an advanced stage of development. The mother offered no resistance on being handled, and was put into a

small school satchel and carried to the State Geologist's office, a mile away, with two empty fruit jars lying on her. That night she was kept in an empty boot-box. This was some eighteen inches in height, and from it she made efforts to escape. She would erect herself in one corner until her head was on a level with the edge of the box, but she could get no further. Once in falling down she uttered a shrill sound somewhat like a whistle or the peeping of a young chicken. A cry like that of a young duck has been attributed by some observer to the Siren, but Barton in some of his writings denies the statement that such a sound is made.

The limbs of these animals are very small. For instance, of this one, having a length of thirty-one inches, the hinder limbs are only three-fourths of an inch long, the anterior only one-half an inch. Yet, when it was moving over the ground or the floor, it was amusing to observe that its feet were put forward and drawn back, as if they really could be of some use.

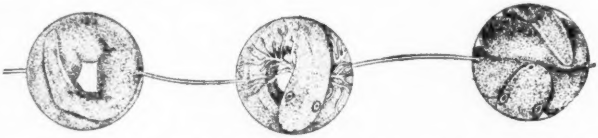
On irritating this Amphiume by pushing her with a stick she would snap at it viciously, and on further irritation would seize it in her jaws and, springing from the floor in the form of a spiral, would turn rapidly round and round, thus twisting the stick in one's hand. Any enemy thus attacked would certainly find his interest in the affair fully aroused.

There are two points in the structure of the adult to which I wish to call attention; although no doubt they have already been observed by anatomists. The first is that there is a little lobe of skin forming the anterior boundary of the gill-opening, and another forming the posterior border. These can be very closely applied to each other, and seem to form a very efficient valvular apparatus, by means of which this useless relic of its larval life may be closed up. The other structure is connected with the mouth. The lower lip is formed of a fold of skin that is separated from the skin of the throat by a deep groove that runs from the corner of the mouth to near the symphysis. This fold has a thin sharp edge, and is directed downward and outward. The upper lip also has a sharp edge which, when the mouth is closed, widely and closely overlaps the lower lip. This arrangement of the lips and that of the gill opening seems to me to have relation to the burrowing habits of these animals, and are designed to prevent the mouth and pharynx from being filled with mud.

The eggs of the Amphiume are the most remarkable that I know of as occurring among the Amphibians. The young, which now constitute the whole contents of the eggs, are surrounded by a transparent capsule about as thick as writing paper, and these capsules are connected by a slender cord of similar substance. It is as if the gelatinous mass surrounding the eggs of the toad should become condensed into a solid covering and a connecting cord. How many strings there are of these eggs I cannot determine with certainty, on account of their being inextricably intertwined; but, since there are four ends visible, there are probably two strings, one for each oviduct. For the same reason I have not been able to count the eggs. A careful estimate makes at fewest 150 of them.

The eggs, in their present state, are nearly globular, and average about 9 mm. in diameter. Their distance apart on the string varies from 5 to 12 mm.; fourteen of them were counted on a piece of the string nine inches long. At this rate the whole mass would form a string about eight feet long. The connecting cord varies from 1.5 mm. to one-half that diameter. The eggs greatly resemble a string of large beads.

The young are coiled within the capsules in a spiral form. On removing them and straightening them they measure about 45 mm.



in length. The color is dusky above, with indications of a darker dorsal stripe, and on each side a similar darker band. Below, the color is pale. The body is proportionally stouter than in the adult and the head broader. The fore and the hind feet have each three toes.

The young possess conspicuous gills; and, since they are evidently near the period of hatching, it is but fair to suppose that they would continue to retain these gills for some time after exclusion. The gills are three in number on each side, and are simply pinnate in form. The median gill is longest, measuring some 9 mm. in length. From its main axis there arise about ten delicate twigs. The other gills are somewhat shorter, and give origin to about eight lateral twigs each. In all these filaments may be seen the blood-

vessels filled with the large blood-corpuscles for which Amphiuma is noted. Three gill-slits are open, of which the two posterior become closed in the adult. The eyes appear to better advantage than later in life.

The finding of these young, nearly ready for active life, in such an unexpected situation suggests some interesting problems. At what period of their development are these eggs deposited? If at an early period, the mother must incubate them for a considerable time. If at a late period, why should they be placed in such a situation? In either case it appears to be quite probable that they are fertilized before they are deposited. Again, how are the eggs in such a dry situation saved from being thoroughly desiccated? They are, I think, kept moist by the body of the mother as she lies coiled around them. My remembrance of her as she lay when first exposed is that she was much plumper than she now appears in alcohol; and when she was laid down on the office floor every spot she touched was made wet. The source of this water I do not know; but it appears probable that it came from the numerous glands that fill the skin, and that the mother makes nocturnal visits to the water to lay in supplies.

Another question to be considered is this: What is to become of the young when they are hatched? How can these feeble little animals make their way to the water some rods away over ground that is covered with rubbish, dry, and full of cracks? How is it brought about that their delicate gills are not withered when exposed to the dry air? Is it possible that, like some species of snakes, the young crawl down the mother's throat while she carries them to the water? It has been suggested to me that just before hatching she may carry the eggs in her mouth to the water; but the whole mass could not be taken into the mouth, and she could only carry them as a dog carries a large bone. It is evident that we have several things yet to learn about the habits of Amphiuma.

By means of dissections and microscopical sections I have made some observations on the structure of the young of the Amphiuma as they were found in the eggs above described. A thorough study is being made of these embryos, and I hope soon to publish a paper giving details and drawings. I here note the most salient features of the skull and shoulder girdle.

As might be expected of the young Amphiume, hatched in a situation removed for some distance from the water in which it is to pass the greater part of its life, and to which it must with some difficulty find its way, its whole organization is in a far more advanced stage of development than is that of those Amphibia which are excluded directly into their yielding native element. A comparison of the skull of the young Amphiume with that of the larval axolotl, as described by Messrs. Parker and Bettany, shows that the former corresponds in many respects to the earlier phases of the fifth stage of the latter. The axolotl in this stage is $1\frac{1}{4}$ inch in length, but when hatched was only about one-third of an inch long (Morphology of the Skull, p. 107).

One of the most interesting features of the skull is the deficiency of cartilage in some regions. The otic capsule is well developed and large. Enclosed within it are the semicircular canals and a large otolith. The notochord runs well forward and is partially ensheathed with bone. The exoccipitals, also, are ossified down almost to the notochord, and the ossification extends into the condyles. On each side there is a narrow band of cartilage that rises up from the hinder end of the ear-capsule toward the middle line, but it lacks considerably of meeting its fellow. Nowhere does the cartilage extend to the middle line above the brain, and nowhere is the brain-cavity roofed over with bone. In the basilar region there is on each side of the notochord a large elliptical fenestra in the cartilage, so that there is only a narrow band lying along each side of the notochord, and a very narrow strip attached to each otic capsule. The trabeculæ are united around the extremity of the notochord, and send back on each side a process to the otic cartilages. These trabeculæ enclose a very large oval pituitary space. They are narrow and, meeting in front in the ethnoidal region, coalesce for a very short distance. There are very short decurved cornua and narrow bands that run outward beneath the nasal sacs. From each trabecula there is given off on the outside a band of cartilage that runs forward and outward, and near its termination sends outward a narrow strip of cartilage over the posterior end of the nasal sacs. This process I regard as the antorbital. There is what appears to be a small postpalatine and a small pterygoid cartilage that does not extend back to the suspensorium. The latter is broad and is directed forward. There is a stapes with the facial nerve passing

beneath it. Meckel's cartilage runs forward nearly to the symphy sis. The hyoidean arch consists of a short hypohyal and a longer ceratohyal. The latter has along its inner side a narrow and easily separable splint of bone. The branchial apparatus is much as in the adult. The first arch is partially ossified. No other ossifications than those mentioned are found in the cartilaginous cranium.

There are several membrane bones. A large parasphenoid underlies the pituitary space and the basilar region. In front of this, in the roof of the mouth, are dentigerous vomers. The maxillaries are probably not represented by actual ossifications, but two rows of dental papillæ shows where they will appear. There is no palatine or pterygoid. The premaxillaries are present and completely consolidated. Their nasal spine is long and they bear prominent teeth. The side walls of the skull are protected by small frontals and larger parietals, but it is the frontal process alone of the parietal that is present. The suspensorium is partially covered by a squamosal.

The Meckelian cartilage appears to be ensheathed, as in the adult, by only two bones. One of these is the dentigerous dentary, which almost meets its platetrope at the symphysis. The other, lying along the inner side of the mandible, extends from the posterior extremity of Meckel's cartilage to a point two-thirds of the distance to the symphysis. It may be regarded as an angulo-splenial. It bears no teeth, as does the splenial frequently in the urodeles.

The shoulder girdle consists of scapular, coracoidal and precoracoidal portions, with no ossifications. These elements lack much of meeting in the middle line of the body below. There are a humerus, radius and ulna, carpals and phalanges. The humerus alone has a center of ossification.

The anterior vertebræ, at least, are ossified, the neural arches having coalesced with the sheath of bone surrounding the notochord. The upper portion of the neural arch is not yet ossified.

Only cursory observations have been made on the brain. As a whole it is far less elongated than in the adult. This shortening is due principally to the prosencephalic lobes, more than half of whose length lies alongside of the di- and metencephalon. Laterally, the epencephalic folds run so far forward as almost to touch the posterior extremity of the cerebral hemispheres.

EVOLUTION IN THE PLANT KINGDOM.[1]

BY JOHN M. COULTER.

PERHAPS I should apologize for selecting a subject that has anything to do with so hackneyed a theme as evolution; but you will discover that I intend neither to explain nor defend it. In this presence neither should be necessary. The purpose is to give an illustration of evolution from the plant kingdom, chiefly because illustrations of this law are commonly taken from the animal kingdom, and also because the case among plants is even more striking. One who staggers at the evolution of the horse can find among plants such interminable intergrading that fixity of species becomes a dream of the past, when they were arranged like puppets that popped up in their places when called for, always looked just alike, and were perfectly expressionless. Zoologists are fortunate in having as their stock-in-trade forms of life in which man is specially interested, both as an acquaintance and a kinsman. The public that listens with pricked-up ears and discusses endlessly concerning the evolution of birds, mammals and man, and thus brings a certain popularity to zoology, cares not a straw for the wonderful structures of Gymnosperms and Lycopods, although furnishing irresistible arguments in favor of a theory that has revolutionized scientific thought. One sort of compensation has been that botanists have been considered a sort of harmless folk, while zoologists are "infidel," or "progressive," apostles of darkness or of light, according to the standpoint of the speaker.

Botanical work has been no less effective and advanced in these latter days; but it lacks that possibility of spectacular display which would keep it in the mouth of the public. Monkeys and men the public wants to know about, but Pteridophytes and Phanerogams are decidedly prosy.

It will be found, however, upon a fair examination, that Botany

[1] Presidential Address before the Indiana Academy of Science, December 28, 1887.

and Zoology are so mutually dependent and helpful that one cannot advance without the other, and the thoughts of both upon such a great question as evolution are practically the same.

Turning aside, therefore, from the broad and much-travelled highway which leads from the Moners to Man, we will strike into a by-path, which extends from Protococcus to Phanerogam, and point out a few of its most salient features. Zoologists should be interested in noting how the same ideas have been worked out in the into great kingdoms, and all should remark the wonderful unity of purpose pervading the whole domain of life.

I shall make no attempt to outline a great scheme into which every plant, however formed, shall fitly fall. If I were younger or less acquainted with botany, I could do this; for a young botanist usually begins by attempting to remodel all existing schemes of classification, just as a young college graduate can put veteran statesmen to shame. Botanists have no family-tree arrangement for plants, and will not attempt the construction of one until they know more about the life-histories of the lower groups and more about structure in all the groups. As Dr. Farlow said, in his Vice-Presidential address before the last meeting of the American Association for the Advancement of Science: "On abstract grounds alone, I presume that few botanists would object to the statement that all plants have developed from simple ancestral forms which were nearly related to some of the lower animals. But when it comes to saying in anything like a definite way that certain existing forms have arisen from other lower existing forms or their immediate allies in some past epoch, and so on, until the lowest form is reached, botanists may well insist that imagination should not be allowed too large a scope in supplying missing links. It is precisely in this point that zoologists have an advantage over botanists. The palæontological record of lower animals is more complete than that of lower plants, so that where the zoologist might reasonably form an hypothesis the botanist must rely more on his imagination, until in the end he finds himself in the possession of a chain composed, to a considerable extent, of missing links. As it is, if we would consider the evolution of plants, not getting much light on the progress of the lower forms from palæontology, we are compelled to trust largely to plants as we now find them, and to ask what are the inferences we are permitted to draw from existing structures and conditions."

Not so very long ago it was thought that at least one fact in classification was impregnable, viz., that there were two great and very distinct groups of plants, called Phanerogams and Cryptogams. These two were set off against each other as antipodal groups, between which there was nothing in common. Unfortunately, the names given to these groups were simply an expression of the botanical knowledge of the time. "Apparent reproduction" and "hidden reproduction" may have correctly expressed the facts with respect to these two groups once; but they are very far from doing so now. The modern botanist, with his more complete appliances and methods, has begun to resolve the great nebulous mass of Cryptogams, and has discovered in it distinct systems and groups. The whole subject of Cryptogamic classification is, of necessity, quite inchoate. Certain groups and relationships have been distinctly defined; but among them and around them there float numerous hazy forms that refuse to be classified. Our knowledge is not sufficient to attempt the work with any degree of certainty, but certain broad principles have been struck out which will serve to guide.

It is known now that Phanerogams form but one of several correlative groups. The most useful scheme of classification at present makes the number seven. These seven primary groups must be considered merely as convenient pigeon-holes in which to distribute our facts.

It is not my purpose to go into the details of any supposed order of evolution of the plant kingdom, but to give some general thoughts concerning it and to trace through the development of a single structure. Generalization is always easier than details; for in it one is never embarrassed by the facts.

It seems probable that the plant kingdom must have begun in some such form as Protococcus, the common green slime found staining foundation stones, bark, etc. It surely represents the unit of structure and of function in the vegetable kingdom. We can conceive of no simpler plant-form than a single chlorophyll-bearing cell. Some of you will recall the fact that we have unicellular plants without chlorophyll, such as yeast and bacterial forms; as well as forms called plants that seem to be mostly naked protoplasm, such as slime moulds; but the former probably represent degraded forms, while the animal or plant character of the latter

remains in doubt. At any rate, they probably have a far greater complexity than was formerly supposed. We have thus come to consider protococcoid forms as our foundation-stones in rearing the structure of the plant kingdom. Through all the Thallophytes (representing the four lowest of our seven primary groups) there run two parallel lines, the typical or normal plants, containing chlorophyll; and the degraded plants, which are destitute of chlorophyll. This distinction is a very deep-seated one in the plant kingdom, for chlorophyll-bearing plants alone can do normal plant work, viz., the conversion of inorganic to organic material through the agency of chlorophyll and sunlight. Plants without chlorophyll must live as parasites or saphrophytes, a degraded habit which leads to degraded structure. The former in the first four groups, are called Algæ, the latter Fungi. The general opinion, brought out clearly in the address of Dr. Farlow, already referred to, is that Fungi are degraded representatives of Algæ—relatives in reduced circumstances, whose lazy habits of parasitism have entailed upon them degenerate bodies. Just what Fungi have descended from what Algæ it is perhaps impossible to say. The chances are that some of our important Fungi are degraded representatives of algal forms which no longer exist. Specific statement with regard to this relationship is little better than guessing; but the general proposition seems to be fairly well established. We have advanced, then, thus far: that of the two parallel lines, Algæ and Fungi, which run through the four lowest plant groups, the plant kingdom is to be considered as having advanced in the line of the Algæ, the chlorophyll-bearing line; while the Fungi are simply so many degraded forms, which lie strewn along this line of general progress, like drift wood stranded along the banks of a stream. For our purpose, then, the Fungi are to be dismissed, their probable origin having been sufficiently indicated. Starting, then, with protococcoid forms, advancing along the lines of Algæ, and into the chlorophyll-bearing members of the groups above, what notions of evolution can be obtained? Examining our present schemes of classification it will be discovered that chief stress is laid upon the methods of sexual reproduction. It is, as yet, the best thread upon which our facts can be strung, and it usually expresses so thoroughly the highest effort on the part of the plant, that as it advances from simplicity to

extreme complexity it seems but fair to consider it a good index of relative rank. I intend to give in merest outline the development of sexual reproduction, guarding such an attempt with the following statements:—

1. This is taken as but a single striking line of development, and must be understood to be accompanied by many other details in asexual reproduction and vegetative structure which bear it out but which we have no occasion to mention. Just as in describing the evolution of the horse the toes are seized upon as the one among other structures most striking and most simple of presentation.

2. There are hosts of side issues which represent departures greater or less from this general line of advance, and which cannot be taken into account in this general sketch. In general, they can be all explained by the law of adaptation.

3. Even the line I propose to follow can be but imperfectly presented; as there is not knowledge sufficient to make it as complete as we would like it, and not time enough to present it as complete as we know it.

Taking, therefore, this thread of sexual reproduction as a guide through the labyrinth of plant forms, we may come to some glimmer of light.

Naturally, the lowest group would contain those plants in which no sexual reproduction has been discovered. In recognition of this position, as well as their probable position in point of time, they have been called Protophytes, or "first plants." The lowly character of lacking sexual reproduction is further borne out in their structure, for they are mostly one-celled forms. In this group stands Protococcus as a type, a single-celled chlorophyll-bearing plant with no discovered sexual reproduction; and, as degenerate representatives, the bacteria and yeasts. You will notice, however, that the definition of this group, on the basis we have adopted, is a negative one, being not as much what we have found, as what we have not found. It follows that this group furnishes a kind of limbo to which all one-celled plants are consigned, in case no sexual reproduction is found, a sort of unresolved nebulous mass, in fact, a cloak for ignorance. It is like the man who undertook a great scheme of classification, and made his two principal divisions "things that I know" and "things that I don't know." The first group he could classify reasonably well; the second he did not have to classify.

In this lowest chamber of Protophytes, every now and then the garment of sexual reproduction is discovered, and its wearer invited to take a place in some upper chamber. But the chances are that the chamber will never be completely emptied, and that there will always be some plants called Protophytes.

In the second group we would expect to find the beginning of sex-reproduction in its simplest form; and to understand what the simplest form would be, the nature of sex-reproduction must be defined. It consists in the mingling of the contents of two cells to form a new one. This new cell is the progeny, and develops more or less directly into the structure of the parents.

Applying this definition to some one-celled form as Protococcus, the simplest possible method of sex-reproduction would be for two cells to come in contact and mutually discharge their contents into a blended mass which becomes a new cell and presently resembles the parents. Such is the beginning of sex-reproduction as we find it in the second group of plants; but it will be noticed that there is no distinction of sex. Both cells are constructed alike and act alike; neither is receptive, for the new cell is constructed upon neutral ground. Sexuality has been attained, but not bisexuality. For this reason, the second plant group is frequently called the "Unisexual Group"; or, from the fact that the cells are for a time yoked together, they are technically called Zygophytes, or "Yoked Plants." In this group, not only is sexuality begun, but bisexuality is hinted at. Plant bodies now begin to consist, not of single cells, but of cell-groups, usually arranged in a chain, forming filiform or thread-like plant bodies. In these filaments or chains of cells, any cell (for they are all alike) can become a reproductive cell and join issues with any other cell, either in the same filament or in another. There is no setting apart of special cells to do this special work, for it is done equally well by all, and all are ordinary vegetative cells. The first hint at bisexuality comes with the fact, that one of these conjugating cells becomes receptive, receiving the contents of the other, and within it the spore or progeny cell is formed.

Such is the case in the common Spirogyras, or "frog-spittles." Although one cell becomes receptive, there is no difference in form nor in contents, and it seems immaterial which becomes the receptive one. In other forms, the development of the spore within the

receptive cell demands more or less change of form, thus making a cell differing in appearance from the ordinary ones. To sum up the general phases of this advance in the second group, or Zygophytes; sexuality is attained, at first with no distinction of sex; then one cell becomes receptive, but differs in no respect from any other in form or contents; and finally, the receptive cell becomes more or less changed in form by the development of the spore.

In the third group we would expect to find bisexuality distinctly worked out, but of the simplest kind. The simplest kind of distinct bisexuality would consist in setting apart two cells for the special performance of this function, differing from the ordinary cells of the plant body and from each other in form and contents. Naturally the receptive or female cell, in which the spore is to develop, would be the larger, probably the largest cell produced by the plant. Such is the average condition of sexuality in the third group, called Oöphytes, or "egg-spore plants," in reference to their large spores. It is to be noticed that these male and female cells differ in form and function only from the ordinary cells of the plant body; they are not favored and cared for by any sort of protection. At this point we are confronted by a phase that needs explanation. The life-history of every plant may be considered a cycle, from the spore which produced it round to the spore which it produces. The cycle is traveled continuously without cessation, except at some one point, which is known as the "resting stage." Every plant, in the life cycle referred to, must, at some point, pass through a resting stage, in which condition the plant activities lie dormant, as if to gather strength for the rest of the journey. This stage must always be a protected one, protection which not only shuts out adverse external conditions at a time of low vitality, but prevents response to favorable ones until after a certain lapse of time. In the groups already considered, this resting stage occurs at the spore phase. The protection provided is simply a thick heavy wall about the spore itself; and in this condition the plant exists for a time and then runs its cycle, round through parent form to spore again. To pass through the resting stage at the spore phase is characteristic of a low type. In the third group the resting stage is pushed gradually forward, until the sex-spore becomes, not a rather permanent phase, but simply one of the transient phases, the resting stage occurring after the spore has developed subsequent structures.

The next phase in the sex-reproduction, the one naturally expected in the fourth group, is the protection of the male and female cells or organs. Set apart heretofore in form and function, they are not protected; but in the fourth group this is gradually and at length very completely provided for, as indicated by the group name, Carpophytes, or "plants with spore cases." In certain members of the group—those which look towards Oöphytes—the male and female cells are at first as naked as in Oöphytes, and if the spore passed into the resting stage the plants would belong to that group; but the spore, as soon as formed, proceeds to develop other structures, and, along with the female cell in which it is contained, develops a complex structure called a spore-case, and this is the resting stage.

Summing up the advance made in the fourth group, we find male and female cells distinct in form; the latter finally protected; and the sex-spore ceasing to be the resting stage, and becoming an evanescent phase which passes directly into a complicated structure, which itself is the resting stage. Subsequently, from this complicated structure, or "spore-case," forms like the parent plant are produced by means of so-called spores, not formed by sex-union, but by ordinary cell division, and for that reason called asexual spores. They are simply reproductive bodies cut off from the parent stock, and are chiefly for the dissemination of the plant, no more a product of the sex act than the buds used in grafting or the "slips" in transplanting; but they are the "spores" commonly spoken of among cryptogams, and their name is legion. The essential difference between sexual and asexual spores cannot be too strongly pointed out, for they have led to endless confusion of ideas. Note now the relation of things in this fourth group. The sex-spore produces the structure called the spore-case, which in turn produces asexual spores by ordinary cell division, which in turn reproduces the original parent. In this group, therefore, in the effort to protect the progeny the resting stage was pushed forward, and that condition of things known as "alternation of generations" originated. As a result, we have in a single life-cycle two plant phases, each producing spores, but in a very different way. One phase bears the sex-organs and produces the sex-spore, and hence is called "the sex-plant;" the other is produced by the sex-spore, bears no sex-organs, produces asexual spores, and hence is called

"the asexual-plant." The asexual spores produce the sex-plant again, and so the cycle is completed. The idea of protecting the sex-organs or their progeny, begun in the fourth group, becomes more and more fully developed in the groups above. After the covering to the female-cell is established there remains a neck-like passage-way. This passage-way becomes more elongated, and more or less guarded, until in the highest group it too is completely blocked up by loose cellular tissue, which must be penetrated by what is called the "pollen-tube."

To summarize at this point: we have an asexual group as the lowest; then a unisexual group; then a bisexual one; bisexuality appearing as the goal in the first three groups. In the fourth appears the idea of protection, which gradually becomes more and more perfected in method, until, without any sensible break in the series, we reach completest protection in the seventh group, or Phanerogams. Also in the fourth group, after bisexuality had been attained, we find alternate generation, and it is in the development of that character that we find the most striking line of advance from the fourth group to the seventh. Keep in mind that the same road is also completely graded and bridged by way of "protection," as has been already referred to. Given, then, as our starting-point (1) a sex-plant which carries sex-organs and produces a sex-spore; and (2) a resulting asexual plant which produces asexual spores; and remembering that the two are but arcs of the same circle and alternately produce each other, what is the next complication that indicates advance?

The next step, besides the completer protection already referred to, is the completer setting apart of the two phases, so as to make them in structure what they are in function, distinct plants. In members of the fifth group, mosses for instance, we find this to be the case. The ordinary moss-plant, which bears the sex-organs, is, of course, the sex-phase; and borne upon it, though as organically distinct as if it grew upon any other mechanical support, we find the structure which develops from the sex-spore, the so-called "fruit," or spore-case. This is the asexual phase, and produces within itself asexual spores (the only spores meant in the ordinary description of mosses). These spores, in turn, produce the sex-phase, or ordinary moss-plant, and the cycle is complete. There is here a distinct setting apart in function, and, as usually follows, in

form also. To the one phase is assigned sex-reproduction; to the other the dissemination of the plant by asexual spores. The ordinary vegetative structures, representing root, stem, and leaves in the higher groups, are here included in the sex-phase also; so this phase is the prominent one, the one ordinarily observed and spoken of as "the plant;" while the asexual phase is more inconspicuous, and, being mechanically borne on the other, seems to be but a part of it.

From this point on, the tendency is to confine the sex-phase more and more entirely to the business of sex-reproduction, and to transfer the vegetative structures more and more completely to the asexual phase. The result is, that as we advance towards the higher groups the sex-phase becomes less and less prominent, as the function is taken away from it which involves size and display; while the asexual phase, taking on the function involving display, becomes more and more prominent, and is popularly styled "the plant." So that, while "the plant" in the case of mosses is the sexual phase in the life-cycle, "the plant" in higher groups is very probably the asexual phase, representing the so-called "fruit" of the moss. As the sex-phase is to be more and more confined to sex-reproduction, it can easily be understood how it can be reduced more and more, until it has only the cells actually needed; and these cells may be reduced to two, one to represent the plant, and the other the sex-organ growing upon it. This seems to represent the goal set before the sex-phase, when in the sixth group the vegetative structures begin to leave it. From this point on evolution reduces and simplifies the sex-phase, increases and makes more and more complex the asexual phase. The sex-phase thus begins simply in the lowest groups and ends simply in the highest, reaching in the fifth probably its greatest complexity. While this is true of the structure of the sex-phase, it is not true of the sex-function, for the very highest possible degree of differentiation in this regard is attained in the highest group.

In the sixth group, represented by ferns and their allies, we find a very wide distinction between the sexual and asexual phases; the latter having become very prominent and having possessed itself of most of the vegetative structures, being the ordinary fern-plant, with its great display of vegetative structures and asexual spores, but no sex-organs. Linnæus may well have examined

the fern in vain for any evidence of sex-organs, for he only knew of this prominent asexual phase, and in his despair consigned the group to "Cryptogams," "hidden sexuality." The asexual spores (borne, you may remember, upon the leaf-structures of the fern) develop, of course, into the sex-phase; but that is so small and hidden among the mold in which the spore has fallen, that it may well escape observation. It is simply a minute flat disk-like body, with vegetative cells and root-like processes enough to make it able to live long enough to accomplish its function of sex-reproduction. But it bears the sex-organs, produces the sex-spore, and from it there arises the beautiful or stately asexual plant. The reduction of the sex-phase could go no further than this, and at the same time compel it to make its own living from soil and air. If any more reduction be made, the sex-phase cannot be organically separated from the other, but must depend upon it for elaborated food.

By this means the utmost possible reduction could be reached, and we must expect this to be the next step in advance. For instance, the asexual spores of the fern are scattered over the soil. From them springs the reduced sex-phase, known as the prothallium, and capable of independent existence. Any further reduction, which would make it incapable of independent existence, would necessitate that the asexual spore be not separated from the asexual plant, but developed into the prothallium upon it so as to receive elaborated nourishment. The reason why a prothallium cannot be indefinitely reduced, and still retain the power of independent existence, is not far to seek. It is on the same principle that a small battery cannot work an indefinite amount of wire. The formation of high-grade reproductive cells is an exhaustive work, and it would require more than a few cells to manufacture such an amount of highly organized substance from crude material. Hence we reach a point, beyond which it would be a physical impossibility to reduce the prothallium, without arranging to supply it with material already highly organized.

Remembering, then, that from the sixth group, represented by ferns, higher rank is to be marked by a reduction of the sex-phase or prothallium, which finally cannot be separated from the asexual plant, let us note a new phase of differentiation which begins to be prominent in the upper members of the sixth group, and continues

as the highest expression of differentiation in the seventh and last. Although vegetative organs have departed from the sex-phase, there still remains a double function, namely, the production of male and female cells or organs. It seems to be a law, that so long as anything remains to be differentiated, differentiation will continue; and the separation of the sex-organs is its next possible expression. Instead, therefore, of having a single prothallium bearing both male and female organs, we find two prothallia; one male and the other female. This state of things is reached by one set of organs first becoming functionless, and finally being suppressed. Remembering that these prothallia are developed from asexual spores, it does not seem strange that this diœcism extends presently to these spores themselves, and that we soon find what may be styled (from the nature of their product) male and female asexual spores. This brings us to the heterosporous arrangement, a feature which continues to the last, and which must be considered a high-rank character, possessed only by the higher members of the sixth group, and by the seventh; and yet, through the very midst of this condition of things, accompanied as it is by many intergrading characters in all the other plant structures, the old abyss between Cryptogams and Phanerogams was supposed to run. To sum up the lines of advance, with which we enter the group Phanerogams, we find male and female spores, producing male and female prothallia, and those prothallia so much reduced that not only do they not become separated from the asexual plant, but are developed within the asexual spore itself. But these same important characters are to be found among the highest Cryptogams, and we must conclude that any line of separation is one of our own drawing, and has no representation in nature.

It remains to apply to the well-known parts of any flowering plant the terminology that we have been using in outlining the evolution of the sex-apparatus. The asexual phase, or part of the cycle, is "the plant" with its rich display of vegetative organs, consisting of root, stem, leaves, and their various modifications. This asexual phase produces asexual spores of two kinds, called male and female, because they are to produce male and female prothallia. It would be an interesting line of development to note the gradual differentiation of the apparatus for making these asexual spores, but that is aside from our purpose. The

final result is, that in the flowering plant we are considering, highly specialized sets of organs produce the two kinds of asexual spores, which have been called pollen-grains and embryo-sacs. It seems strange to be forced to give up pollen-grains or embryo-sacs as sexual affairs, for in our old notion of things they represented the very essence of sex; but the fact remains that they are asexual spores and simply give rise to prothallia which bear the sex-organs and give rise to the sex-spore.

The two prothallia which are developed from these asexual spores have reached the highest degree of reduction, developing within the spores themselves. In the case of the pollen-spore two or more cells are developed, which may be easily seen by the use of the proper reagents, and this small group represents the male prothallium, one of the sex-phases in the life cycle. This much reduced plant sets apart one or more of its cells to do vegetative or growth work, and another to be the male organ. A very vigorous growth of this prothallium is demanded in the development of the pollen-tube, through which the male cell discharges its contents. This pollen-tube does not usually find an open passage-way, but one that is blocked up with spongy tissue, called "conductive tissue," through which it makes way like a parasite invading the tissues of a host plant.

In the case of the embryo-sac, the female asexual spore, the development of the prothallium is still feebler, the cells representing it not only being few in number, but free from each other,—a sort of disorganized tissue. The cells representing the female organs are clustered near the apex of the embryo-sac, forming what we now call the "egg-apparatus," while those that probably represent the vegetative cells of the prothallium are clustered at the other end of the embryo-sac, and are styled "antipodal cells." In pines, representing the lowest group of flowering plants, the female prothallium is a very distinct and compact tissue, bearing regulation female organs, the so-called "corpuscula." This but shows their position upon the lower border line of Phanerogams. The sex-phase in the life cycle, therefore, which in mosses stood for the whole plant as we ordinarily recognize it, in Phanerogams has become reduced to little clusters of cells developed within the pollen-spore and embryo-sac, so inconspicuous that it has remained for the modern reagents to discover their existence. The real sex-

spore, or oöspore of Phanerogams, is the single fertilized cell in the embryo-sac, which at once develops into the embryo, at which point Phanerogams pass into the resting stage, in this group called "the seed." The sex-spore, since the fourth group, has become such an evanescent thing, so out of reach of common observation, that very naturally it has been the common opinion that the comparatively permanent asexual spores are sex affairs. Sex-spores are directly formed by sex-union; while pollen-grains and embryo-sacs are never formed in any such way. Thus have I hastily traced one of the principal threads upon which our botanical facts are strung. And as one examines the subject in more of its details, he becomes irresistibly impressed with the idea that here is a great scheme of development, directed by laws of which we are beginning to catch glimpses, and by which the whole fabric of a great kingdom has been beautifully and continuously worked out.

RECENT LITERATURE.

The Geological History of Plants. By Sir J. William Dawson, C.M.G., LL.D., F.R.S., etc. International Scientific Series. New York, 1888.—This book is a striking example of the truth that scientific specialists cannot be induced to say much about things which they have not themselves carefully studied. Purporting to treat a great department of palæontology from a cosmopolitan standpoint, it is really a summary of the author's own extensive researches within the British American Provinces, enriched by much comparative matter drawn from similar phenomena in other lands. What is therefore lost in generality is gained in thoroughness and reliability. There is no branch of science that stands more in need of summarizing and systemizing than that of palæobotany, and every book that successfully attempts this should be warmly welcomed. With the above qualification this work does this, and it is therefore a valuable contribution to the thus far scattered and desultory literature of the subject. Taking up the several geological formations in their ascending order, the characteristic vegetation of each is ably portrayed by the author, though with an unevenness of treatment corresponding to the imperfection of the geological record in the region to which he has devoted his life. The vegetable origin of the Laurentian graphite is defended with great force, and the existence of a primordial flora contemporaneous with *Eozoon canadense* is maintained. Most of the alleged

plants of the Cambrian and Silurian seas are thrown out, but Nematophyton, Protannularia, and some species of Buthotrephis are marked as genuine. A special feature is the working out more elaborately than in any other place of his theory of an early Rhizocarpean flora culminating in the Devonian. Much space is given to the flora of this period, so well developed in Acadian territory, and so unimportant in other countries, and his name "Erian" is constantly used and specially defended. The Carboniferous flora takes a subordinate rank, but the extended notes to that chapter are crowded with valuable information, much of which would be new to any but the thoroughly informed specialist. The early Mesozoic (Triassic and Jurassic), not being represented in Canada, is given a very short chapter, largely devoted to the history of Ginkgo and Sequoia as worked out by Heer, Saporta and others. More prominence is given to the Cretaceous, and the interesting plant-bearing deposits of the Kootanie (Neocomian), Dunvegan (Cenomanian), and Belly River (Senonian) series in the Northwest Territories receive special attention. The Laramie group, as it occurs on the St. Mary River, on Willow Creek, and on Porcupine Hill, is also well characterized and illustrated. The great Miocene flora, which ranks next in abundance to the Carboniferous, is passed over nearly in silence, but some very important deductions are drawn from the little florula on Green's Creek, central Canada, in the Leda clay, believed by him to have been deposited at about the time of maximum glacial refrigeration. The work closes with a chapter on the origin and migration of plants, and the relations of recent to fossil floras.

In this book Sir William Dawson naturally takes occasion to give his views on most of the disputed questions in phytopalæontology. A few of the more important of these may be mentioned here: He accepts and reiterates the Brongniartian hypothesis of the greater abundance of carbon dioxide in the atmosphere during palæozoic time, but without denying the possibility of the cosmical origin of portions of it, as maintained by Dr. T. Sterry Hunt. He insists upon the substantial uniformity of the fossil floras, especially the Palæozoic, over the whole globe, and expresses his convictions that, "with reference to the Erian and Carboniferous floras of North America and of Europe, the doctrine of 'homotaxis,' as distinct from actual contemporaneity, has no place." He agrees with Gardner that the Laramie group is probably of the same age as the arctic Miocenes of Heer, and that these are not Miocene but Eocene, also that allowance should be made for differences of latitude, although this is not sufficient to amount to an entire geologic period. On the leading taxonomic question as to the position of Sigillaria, he accepts Williamson's proof of the existence of truly exogenous cryptogams, but from the frequent occurrence of taxine fruits in the same beds with Sigillarian

trunks he inclines to the opinion that these will yet be found attached, and that some forms, at least of Sigillararia, must have been coniferous. In this connection he discredits the statements of Goldenberg relative to the fruits of Sigillaria, but seems to be unacquainted with the important paper of Zeiller, which has certainly done more to settle the question than any other discovery.

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GEOGRAPHY AND TRAVEL.[1]

AMERICA.—THE RIO DOCE.—The Rio Doce, Brazil, an account of the exploration of which was recently read by Mr. W. J. Steains before the Royal Geographical Society, appears small when compared with the mighty rivers around it, yet has a length of rather over four hundred and fifty miles. Its head-waters are several streams rising in the Serra da Mantiqueira, the loftiest peak of which, Itatiaiaassu, 10,040 feet, is the highest known elevation in Brazil. The various streams which unite to form the Rio Doce flow in a more or less northerly direction from the northern slope of the Serra and unite into a main river which, after receiving several tributaries, enters the ocean at about 19° 40′ south latitude. The Serra da Mantiqueira has a general northeast direction, but the irregular line of the Brazilian coast-range is continued northward by the Serra dos Amore, which is cut through by the Rio Doce in its descent from the interior table-lands. The part of the Rio Doce basin lying east of the last named Serra is a densely wooded lowland, sloping upward to a height of about nine hundred feet, and resolving itself near the coast into a stretch of alluvial ground, studded with small lakes communicating by long winding streams called "valloes." The largest of these, the Lago Juparana, is eighteen miles long, and is connected with the Doce by a tortuous channel of about seven miles. It is fed by the Rio San José, a still unexplored stream, flowing through districts inhabited by wild Botocudos. The forests around it abound in the Jacarandá (*Bignonia cœrulea*), or rosewood tree. The Rio Doce is navigable as far as Porto de Sonza, one hundred and twenty miles from its mouth. Here occur the rapids which mark the crossing of the Serra dos Amores, and falls and rapids are abundant above this. There are, as yet, only three settlements—Linhares, Guandu and Figueira—on the banks of the Doce, though for the greater part of its course grand virgin forests, filled with a hundred varieties of

[1] Edited by W. N. Lockington, Philadelphia, Pa.

the choicest timber, come down to the water's edge in a wall of gloriously wild tropical vegetation. The valley is the home of the Botocudo, who has not yet renounced cannibalism. Mr. Steains does not place the number of these Indians at more than seven thousand, yet states that they form the sole barrier to colonization. Espiritu Santo, the province lying east of the Serra Amores, is at present the poorest province in the empire, and the valley of the Rio Doce is a great gap in the wall of civilization that has been slowly reared along the four thousand nine hundred miles of the Brazilian seaboard. There is not in Brazil a tract naturally richer than that which lies between the Doce and the Mucury to the north of it, yet the Indian is still in possession.

The Botocudos, so called by the Portuguese on account of the "botoque," or lip-ornament, which is the only clothing worn by them, are about five feet four inches in height, broad chested and lean limbed, and with small hands and feet. The plug of wood is first inserted in the under lip when the Indian is three or four years old, and is replaced by a larger until a diameter of three inches is attained. If the lip splits the Indian ties the ends together with bark. The "botoque" is now worn only by the older members of the tribes. The nuts of two or three species of palm form the chief sustenance of these primitive people, and the supply is eked out with game and fish. Mr. Steains ascended the tributaries Tambaquary, San José, Pancas and Rio San Antonio.

In the discussion which followed the reading of Mr. Steains' paper, Mr. C. Mackenzie stated that the custom of wearing an ornament in a slit made in the lower lip could be traced with very few breaks from the Eskimo of the Alaskan coast to Brazil.

The Cassiquiari.—M. Chaffanjon, the well-known explorer of the Orinoco, has carefully studied the communication between that river and the Amazon, by means of the Cassiquiar, and comes to the conclusion that it is of recent origin. The rapid current of the Orinoco, as it passes through a gorge only ninety yards wide in the clay deposits, undermines the banks, and this action, combined with actual overflow in the rainy season, has produced a permanent channel. The clay deposits on the left bank have a slope towards the Amazon.

Asia.—Explorations in Nepal and Tibet.—An adventurous journey through Nepal and Tibet has recently been taken by M. H., a native explorer attached to the East Indian Survey. Disguised as a physician, and provided with a stock of medicines and articles for presents, he ascended the Dudhkosi river through Nepal to Khumbujong, about eighteen miles west of Mt. Everest. The governor refused him further passage, but he succeeded in curing that functionary's daughter-in-law of goitre, and soon after started with her husband on a trading expedition into Tibet. The pass

over the Himalayas, called the Pangula, is about 20,000 feet above the sea. More obstruction was met with at Deprak, the frontier village of Tibet, but leave to advance was at length obtained from the governor of Dingri, who exercises all civil and military jurisdiction over a large tract of Southern Tibet. Dingri has about 250 stone houses, and stands at an altitude of 13,360 feet. From Dingri the explorer proceeded by the Digurthanka plain and Palguche lake (said to have no outlet) to Jonkhajong, the most northwestern point reached. Hence he went southwards to Kirong, followed the Tusuli river for awhile, visited Nubri and Arughat (Nepal), and finally, via Deoghat, reached Tirbenighat, on the British frontier on Jan. 13, 1886. Beyond Kirong, on the Nepalese frontier, the road runs along a gallery of planks laid upon iron bolts driven into the rock. Parts of the plain of Southern Tibet show signs of a former larger population, and it is said that in the last great war between the Nepalese and the Tibetans most of the inhabitants were killed.

Dr. von Luschan's Journey in Asia Minor.—At a recent meeting of the Geographical Society of Berlin, Dr. von Luschan spoke of his explorations in Asia Minor, undertaken chiefly with archæological aims. Dr. Luschan accompanied Otto Bensdorf into Lycia in 1881, and afterwards visited the tomb of Antiochus I., discovered by Otto Predestein in 1882. This is an immense tumulus on the right bank of the Euphrates, between Iskenderun and Bagdad, on the peak Nemrud Dagh (7000 feet). The tumulus is flanked on the east and west by five gigantic figures of gods, sixteen to twenty-three feet high. At a distance of ten days' journey from the coast, the traveler along this route comes upon the ancient bridge over the Boilam-Su, a single stone arch, sixty-five feet in height and 325 in length. It was built by Septimius Severus, Carracalla and Geta, and is to-day in perfect preservation. Afterwards Dr. Luschan took part in the expedition of Count Lanckoroviski, the object of which was the archæological exploration of Cilicia and Pamphylia. In other later journeys Dr. von Luschan turned his attention to the complicated ethnography of Asia Minor. The Turco-Mongolian anatomical type is not to be found among the so-called Turks of Asia Minor. The Mohammedans of the peninsula belong to three types, viz.: Old-Grecian, Armenian and Semitic. The race which gave the religion and language was numerically too weak to influence, to any considerable extent, the physical nature of the conquered people. The Greeks exhibit the same three types, the true Greek predominating along the west coast and on the islands. The Armenians are a compact and homogeneous people, anatomically allied to the Tachkadschy or Alleor of Lycia, the Ansarieh or Fellach of S. E. Asia Minor

and N. Syria, and the Kizilbash and Tezyde of Upper Mesopotamia and Kurdistan. The Turukes are genuine nomads, traditionally from the Hindu Kush. Turcomans and Kurds also occur, besides Bulgarians, Arnauts, Arabs, Gypsies, Europeans and negroes, all of whom have immigrated in comparatively modern times.

AFRICA.—The recent journey of Bishop Parker and the Rev. J. Blackburn from Mombasa to Mamboia, a point situated about 200 miles east of the port of Saadani, fills up another gap in the map of Africa. The region proved to be one of the most varied, mountainous, and richly wooded on the continent, and seems to be a succession of high ridges and valleys. The regions passed through were those of Usambara, Useguha and Nguru. Southeastward of the route taken by the previously named gentlemen, Count Pfeil has been actively engaged in exploring Useguha, along the lines of the Rufu and its tributary, the Mkomazi; then south to the basin of the Wami. From Mbnzini, on the Rukagura, he proceeded southwards across the plains between the Wami and the Geringeri, and then followed the course of the latter river to its junction with the Kingani, finally reaching the coast at Bagamoyo.

GEOGRAPHICAL NEWS.—M. Thonar, who was believed to have perished in the Gran Chaco, has returned to Port Pacheco with his companions.

It now appears that Dr. Meyer did not ascend to within 2000 feet of the summit of Mt. Kilimanjaro.

The volume of water discharged every second by Lake Baikal through the Angara reaches 121,353 cubic feet, and the vertical section of the river at its issue is, according to the *Izvestia*, 17,920 feet.

Gen. A. Houtum-Schindler (*Proc. Roy. Geog. Soc.*, Feb. 1888), gives a summary of the various barometrical and trigonometrical observations that have been made at the altitude of Demavend, the highest peak of the Elbruz Mountains (Persia), and arrives at a result of about 19,400 feet. Although no eruption of Demavend is on record, smoke, or at least steam, has been stated to have been seen to issue from it.

GEOLOGY AND PALÆONTOLOGY.

Notes on the Drift North of Lake Ontario, is the title of a paper read by Professor J. W. Spencer before the Phil. Soc., Washington, March 3d. This short paper is a generalized description of some of the obscure and conflicting phenomena of the drift, of which this notice is an abstract.

Amongst the deposits of the later Pleistocene period, there is a well stratified, hardened, brown clay, charged with pebbles which are more or less glaciated, resting upon the typical blue boulder clay, north of Toronto. In the Canadian classification of the Pleistocene deposits there is no place for this deposit. Indeed, all of the stratified deposits of this region need revision in the light of the progress that has been made in surface geology during the last twenty years. Thus the Saugeen clay is resolvable into three series. The relation of all the clays to the older beaches require special study, as a part of them probably represent the deep water deposits of the Beach epoch, while some of the later beaches rest upon such clays. Around the head of Georgian Bay there are ridges, in the form of moraines, similar to those about the other Great Lakes, reaching to the height of 1300 to 1400 feet above the sea. From the face of the Niagara Escarpment—between Georgian Bay and Lake Ontario—there extends, for over a hundred miles, to near Belleville, a broad zone, of from eight to twenty miles in width, covered with drift ridges, composed of stony clay below, and frequently stratified clay or sand above, having an elevation of 1100 to 1200 feet above the sea, with occasional reductions to 900 feet. These "Oak Hills or Ridges" rise from 300 to 500 feet above the Palæozoic country to the north. The stones in the clay are often glaciated limestone, with only a small proportion of crystalline pebbles or boulders. In the deposits of the ridge native copper has been found; consequently the drift-carrying agent moved southeastward down Georgian Bay, to the west end of the Oak Ridge, and probably throughout its whole length. North and east of Belleville there are many lower and fragmentary ridges, having a trend somewhat across that of the Oak Ridge. The glaciation of the region adds great difficulties to the explanation of the phenomena. The striation in the Ottawa Valley, from Lake Tamiscamang to the junction with the St. Lawrence, is to the southeastward, with very rare local exceptions. Of the Niagara escarpment, between Georgian Bay and Lake Ontario, from 1600 down to 700 feet above the sea, the striæ are also to the southeast; but between these widely separated regions the surface marking of the rocks are

obscured to the west and south by drift, and to the north and east absent or rarely seen, although the crystalline rocks are commonly rounded or very rarely polished, an absence that can only in part be accounted for by subsequent atmospheric erosion. About the St. Lawrence and Lake Ontario the striations are to the southwest or west. Between the Ottawa River and Georgian Bay there is a high prominence, which divided the drift-bearing currents. But north of Lake Huron the glaciation is very strongly marked, and the direction is to the southwest, with very rare local variations.

All the lobes of glaciation about the lakes, from Superior to the Ottawa Valley, radiate backward to the broad and open but low basin of James (Hudson) Bay. The watershed between the lakes and Hudson's Bay during the epoch of the formation of the drift was several hundred feet lower than now—which is about 1600 feet at present—as shown by the differential elevation of the beaches. For this conflicting phenomena of the drift no explanation was offered, but rather sought for.

Some remarks upon the paper were offered by Mr. Gilbert, who had observed the slight amount of erosion in the Ottawa Valley; but he thought that generalized explanations of the drift were very often contradictory when applied to special regions, and that our knowledge of the phenomena would not at present give a satisfactory explanation.

GLYPTODON FROM TEXAS.—In the *Proceedings* of the Philosophical Society for 1884, p. 2, I recorded the discovery of a species of Glyptodon in the valley of Mexico by Professor Castillo, which was at the time the most northern locality at which the genus had been discovered. I can now announce its discovery within the limits of the United States, in Nueces Co., Southern Texas, by my friend, Mr. William Taylor, in the beds which have yielded *Equus crenidens* Cope and *E. barcenæi* Cope, both species of the valley of Mexico.

The present species is represented but by a single segment of the carapace, but as the sculpture of these elements is very characteristic, and as my means of comparison are very large, since my Pampean collection embraces a majority of the species, I venture to describe it. It belongs to the group in the genus represented by *G. clavipes* Owen, and *G. oweni* Nodot. It is a species of large size, with very thick carapace, and with the circumferential areas of the rosette but little smaller than the central one. The former are regularly pentagonal, the latter regularly hexagonal, and they are separated by well-defined grooves. Deep foramina very few. The surface of the areas is flat and in one plane. The texture of the median area differs from those round it in being impressed with numerous small, closely-placed foramen-like fossæ. Its surface supports no tuberosities. The circumferential areas are marked

with shallow grooves, which issue abruptly near the median border and radiate towards, and some of them to, the circumference, becoming shallowed externally; no tuberosities. Diameter of scutum, 45 mm.; of median area, 17 mm.; thickness, 15 mm. This species is of the same type as that one found in the valley of Mexico, but I cannot speak positively as to its identity. It may be called *Glyptodon petaliferus.*—*E. D. Cope.*

GENERAL.—According to A. W. Stelzner, the Archæan rocks, primitive gneiss, and primitive slates compose the greater part of the sierras which rise out of the Pampas; but granite occurs in most of these sierras, especially in that of Achala. This granite must certainly be pre-Silurian. The principal locality of the Silurian rocks is in the Anti-Cordilleras. Devonian and Carboniferous rocks have not hitherto been found in the Republic, but, possibly, the Carboniferous strata of Southern Brazil and Uruguay may extend into the Province of Corrientes. The Dyas and Trias have, also, not been palæontologically identified. The red sandstone which D'Orbigny believed to be Triassic has been since referred to the Upper Jurassic or to the Cretaceous. Rhætic beds have been found near Mendoza and in the Famatina Mountain, etc. Jurassic beds are exposed in the Espinazito Mountains, and a Jurassic sea extended from the eastern coast far into the interior. The gypsum-bearing sandstone of the passes of Patos and Cumbre belong to the Cretaceous formation, as do also the red sandstone of the Province of Tucuman and that of Jujuy.

PALÆOZOIC.—Hans Reusch (Sep.-Abd. a. d. neu. Jahrbuch für Min., Geol. u. Pal.) describes the geology of a metamorphosed district on the Hardangerfjord, in Norway. The region treated of is on the west coast of Norway, south of Bergen. The foldings of the strata (as shown in the wood-cuts) are most singular. Granite rocks show laminations, are set with blocks of gneiss, or are twisted in inextricable confusion; conglomerates are so compressed that the pebbles form narrow lines; granite forms dykes in diorite, and the whole region is a maze of conflicting strikes and dips.

CÆNOZOIC.—The ninth volume of the Bulletin of the National Academy of Sciences of Cordoba (Argentine Republic) contains descriptions of numerous mammalian fossils from the Tertiary strata near the Parana. Among these are *Cynonasua argentina*, a form allied to the coati, but with seven molars in the lower jaw; a Canis, of about the size of *C. azaræ;* a catlike animal, for which Ameghini forms the genus Apera, and which appears to have been about twice the size of the domestic cat; six species of the rodent genus Megamys,—one of them of almost gigantic size; *Epiblema horridula*, a rodent a little larger than the viscachia; two or three species

of the new genus Tetrastylus; two each of Morenia and Orthomys; *Myopotamus paranensis; Plexochœrus paranensis*, previously described as a Hydrochœrus, but differing from that genus in the structure of the last molar; two forms of the new genus Cardiatherium, etc., etc. Many already known species and genera—such as Toxodon, Paradoxomys, etc.—receive additional elucidation in this text. *Macrauchenia bravardi* and *M. rothii* are separated, under the generic name of Scalabrinitherium; while *Oxyodontherium zeballosi* is equivalent to the *M. minuta* of Burmeister. *Promegatherium remalsumis*, a sloth-like animal, nearly as large as *Megatherium americanum;* and *Pseudolestodon æqualis* is another huge sloth. *Comaphoras concisus* and *Proëuphractus limpidus* are among the new loricate edentates. Remains of Cetacea are abundant in marine beds which overlie the fresh-water strata.

PLEISTOCENE.—Dr. Alfredo Dugès describes in a recent number of *La Naturaleza* a Pleistocene fossil, which he names *Platygonus alemanii.* The skeleton appeared to be complete, but was in great part destroyed during the excavation. The animal was almost double the size of the modern peccary.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—The very interesting paper by Brauno[2] on the palæopicrite of Amelose, near Biedenkopf in Hessen Nassau, contains a full description of this rock and its numerous alterative products. The freshest type of the palæopicrite is composed of idiomorphic olivine, augite, both idiomorphic and allotriomorphic, irregular grains of plagioclose, picotite and magnetite. The augite often shows the unusual alteration into biotite. The principal alteration products of the rock are serpentine, siliciophite, chrysolite, metaxite, picrolite, webskyite,[3] calcite and quartz. The three substances chrysolite, metaxite and picrolite are studied in great detail, and their optical and physical properties are described at length. The author regards them each as a variety of serpentine, the first consisting of slender elastic fibres, the second of coarse stiff needles, and the third being characterized by a radiating structure.

The serpentines, amphibolites and eclogites from the neighborhood of Marienbad, in Bohemia, were formerly regarded as sedimentary beds which had been metamorphosed by the action of granite, which occurs near them in a boss. Patton has recently examined these rocks very carefully. He considers[4] them as prob-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.
[2] Neues Jahrb. f. Min., etc., B. B. v., p. 276.
[3] American Naturalist, Nov., 1887, p. 1021.
[4] Min. u. Petrog. Mitth., 1887, ix., p. 89.

ably the result of the action of dynamic agencies upon eruptive rocks. The serpentines are shown to be derived from a peridotite, composed sometimes of bronzite, hornblende and olivine, and at other times essentially of olivine and tremolite. Different specimens of amphibolites contain zoisite, epidote, augite and talc. The most interesting rocks discussed in the paper are the eclogites. A variety which the author calls kelyphite-eclogite is made up of garnets and hornblende in a groundmass consisting of amphibole and omphacite, so intergrown as to imitate the granophyre structure of certain acid rocks. The garnets are frequently surrounded by a rim of hornblende and plagioclose, which, however, the author is disinclined to regard as a reaction rim, but is rather disposed to look upon as a growth around the garnet as a center. Zoisite, which is also found in these eclogites, is often seen in the thin section to be surrounded by a rim of cloudy substance, which under high powers is resolved into plagioclose, muscovite and a third mineral with the specific gravity and optical properties of topaz, but in which no fluorine could be discovered. Patton supposes it to be an unknown mineral with the composition Al_2 Si O_5.—The saussurite gabbros of the Fichtelgebirge, found in lenticular masses scattered through serpentine layers, which are interstratified with clay slates and phyllites, are regarded by Michael[1] as the result of the alteration of a sedimentary feldspathic gabbro, although it would seem, from his own descriptions, that he would have been equally well justified in concluding that the saussurite gabbro lenses are merely the less altered remains of an intercalated gabbro, whose most altered phases are now represented by the serpentine. The word "saussurite" he would use as a general term to designate a cloudy alteration of plagioclose into two or more distinct minerals. He finds that while in some cases this alteration is into zoisite and serpentine, or some indeterminable mineral, in other cases the new minerals produced are serpentine and a calcium garnet.

Mr. Lawson,[2] of the Geological Survey of Canada, gives an account of the diabase dykes so prevalent in the Archæan region around Rainy Lake. These dykes have a width of from sixty to one hundred and fifty feet. Toward their centers they are composed of plagioclose, augite and quartz, with a greater or less proportion of colorless garnets. The augite appears as an aggregate of little crystals which fill the spaces between the other constituents, and not as one continuous crystal, as is the usual case among diabases. The quartz and garnets are found only toward the centers of the dykes, and are absent at their edges. Idiomorphic enstatite, on the contrary, is a frequent constituent of material taken from the sides of the dykes, and is absent from their centers. The features

[1] Neues Jahrb. f. Min., 1888, i., p. 32.

[2] Proceedings Can. Institute for 1887, and American Geologist, April, 1888.

of these diabases are well worthy of the further study Mr. Lawson proposes to put upon them.—The Rev. E. Hill[1] mentions hornblende schists from the island of Sark, in which he thinks he has found indications of a former bedding and evidences of sedimentation.—Ternier[2] describes very briefly the eruptive rocks of the Mt. Mézeuc region in France, as presenting almost as great a diversity as those of Auvergne. They consist of augite and amphibole andesites, trachytes, phonolitic-trachytes and basalts in the order of their sequence. The basalts are the only ones which are at all widespread in their occurrence.

Mineralogical News.—New analyses of several rare minerals are communicated from the laboratory of the University of Virginia. Mr. R. C. Price[3] found a lump of *tscheffkinite*, from Nelson county, Va., to possess the composition $2\ R\ O.\ R_2\ O_3.\ 5(Si\ Ti)_2\ O_2$, in which $R =$ Ca, Be, Fe, Mg, and $R_2 =$ Ce, Di, La and Fe'''.

Mr. Walker[4] obtained from *genthite*[5] :—

$Si\ O_2$	$Ni\ O_2$	$Mg\ O$	$H_2\ O$	$Fe_2\ O_3$
55.38	17.84	15.62	10.77	.56

corresponding to $\frac{1}{3}\ H_2\ O + \frac{2}{3}\ [(Mg\ Ni)\ O].\ Si\ O_2 + \frac{1}{3}\ H_2\ O$, a meerschaum (sepiolite) with its magnesium partly replaced by nickel. The mineral occurs in thin layers in a sandstone at Webster, Jackson county, N. C. It is amorphous, of a light apple-green color, translucent and greasy. It has a hardness of 2.5 and a specific gravity of 2.53.—Very similar to the last mentioned mineral is a nickeliferous *talc*, from the same locality, in which Mr. Bachman[6] found :—

$Si\ O_2$	$Ni\ O_2$	$Mg\ O$	$Fe_2\ O_3$	$Al_2\ O_3$	$H_2\ O$
53.91	15.91	19.39	1.46	2.65	6.30

—Perimorphs of *pyromorphite* after cerussite and galena are mentioned by Gonnard[7] as occurring in the lead mines of the Puy-de-Dôme, France. In some cases the pyromorphite exists merely as a thin shell enclosing a hollow space, from which the mineral formerly occupying it has been removed by solutions—The same author describes a shell, composed of little rhombohedra of siderite arranged with their axes parallel, enclosing within itself a solution of ferrous carbonate. He also calls attention to a perimorph of pyrite after calcite.—Hall and Tauss[8] have found the

[1] Quart. Jour. Geol. Soc., Aug., 1887, p. 322.
[2] Comptes Rendus, cv., 1887, p. 1141.
[3] Amer. Chem. Jour., Jan., 1888, x., p. 38.
[4] Amer. Chem. Jour., Jan., 1888, x., p. 44.
[5] Chem. News, xxvi., p. 654.
[6] Amer. Chem. Jour., Jan., 1888, x., p. 45.
[7] Comptes Rendus, cv., 1887, p. 1267.
[8] Min. u. Petrog. Mitth., ix., 1887, p. 227.

baryto-celestite, accompanying the wagnerite at Werfen in Salzburg, to consist of 84.8 per cent. of barium sulphate and 15.05 per cent. of strontium sulphate. Like Professor Chester,[1] they regard the substance as an isomorphous mixture rather than as a definite compound.

MISCELLANEOUS.—*Wollastonite* is most frequently found in nature as a newly formed mineral in metamorphic rocks. It has also been detected as a primary constituent in eruptive rocks. Many experimenters have succeeded in obtaining the mineral artificially by means of wet processes, but until very recently all attempts to produce it in the dry way have failed. Doelter,[2] as the result of his experiments, declared that wollastonite could be produced only by wet methods, or at low temperatures in the presence of water vapor. The bearing of such a statement upon the question of the origin of eruptive rocks, is of the greatest importance if found to hold good. Hussak,[3] however, shows that the mineral can be produced by dry methods. He has succeeded in obtaining little monoclinic crystals of wollastonite by fusing together a mixture composed of three parts of $Ca\,Si\,O_3$ and one part of a glass of the composition $3\,Na_2\,O.\,Si\,O_2 + 2\,Ca\,B_2\,O_3$. When examined under the microscope these crystals were seen to possess all the properties of the natural wollastonite.—The anhydrous manganese hydroxide *pyrochroite* ($Mn\,(O\,H)_2$) has been obtained by Schulten[4] in little hexagonal prisms, perfectly transparent, of a light red tint, and with a negative refractive index. His mode of operation was to warm a little manganese chloride with a large excess of a solution of pure potassium hydroxide, care being observed to prevent the access of air during the operation.—Among the large number of artificial crystals made by the late Dr. Ebelmen, Mallard[5] describes one of some interest to mineralogists. It was produced by fusing together a mixture of silica, glucina and borax. In the resulting product were large numbers of little prisms of a positively refracting substance, which corresponded in its properties with the rare mineral *phenacite* ($Be_2\,Si\,O_4$).—Krüss[6] has found that *euxenite* from Norway contains a tenth of one per cent. of the newly discovered element germanium.—Traube[7] notes that the zeolites found in the Striegau granite are colorless when occurring at great depths, but when near the surface are highly colored.

[1] American Naturalist, 1887, p. 852.
[2] Neues Jahrb. f. Min., etc., 1886, i., p. 119.
[3] Mineralogische und Petrographische Notizen, Bonn. p. 9.
[4] Comptes Rendus, cv., 1887, p. 1265.
[5] Comptes Rendus, cv., 1887, p. 1260.
[6] Ber. d. d. Chem. Gesell., 1888, p. 131.
[7] Neues Jahrb. f. Min., etc., 1887, ii., p. 67.

BOTANY.[1]

THE ROOTSTOCKS OF LEERSIA AND MUHLENBERGIA.[2]—*Leersia virginica* Willd., grows in wet, shady places, and starts rather late in the spring. Late in autumn the parts below ground are found to consist mainly of some slender exhausted and dead rootstocks, from one to three or four centimetres long. The internodes of these slender exhausted rootstocks are covered for a part of their length by sheaths of rudimentary leaves, early bearing a very short blade.

A portion, perhaps one-third, of the nodes bear from one to four thickened, scaly rootstocks, which contain nourishment for starting young plants the next spring. In some cases one or more scaly rootstocks appear near the apex of a similar rootstock which survived the winter.

The surviving rootstocks are slightly flattened, one to four centimetres long by three to five mm. in diameter, covered with scales, and are mostly simple, though some of them have short branches. The scales are brown, alternating and two ranked, and on internodes which are from one to two mm. long. The bases of the scales are thickened and abound in plant food.

Leersia oryzoides Swartz, also has rootstocks, the main axis of which is not very unlike that of the former species, though in autumn they are rather stouter, and most of them remain alive and gorged with plant food for use on the approach of the succeeding spring. Many of the nodes bear short, pointed, solid branches, with four to eight nodes. The scales of these buds are mere dead rings or shreds, and are not filled with nourishment in autumn.

The fundamental differences, then, between the rootstocks of these two species are as follows:

1. In winter the main rootstocks of *Leersia virginica* are dead, while those of *L. oryzoides* are alive and abound in food.

2. The scales of the rootstocks coming from the nodes of the main rootstocks of *L. virginica* are broad, firm, and full of plant food, while the corresponding scales of the branches of *L. oryzoides* are reduced to mere dead fragments, containing no plant food. No good specimens of other species of *Leersia* were examined in reference to their rootstocks.

A considerable portion, if not all, the species of *Muhlenbergia* put forth flowering branches. In case of *M. debilis* Trin., some of the lower internodes from the surface to five or more centimetres above frequently branch at the nodes, where there are clusters of

[1] Edited by Prof. Charles E. Bessey, Lincoln, Neb.

[2] Read before the Botanical Club of the A. A. A. S., in New York, Aug., 1887.

bracts or short leaves. The specimens of this species examined were quite erect, not geniculate, nor rooting at the nodes.

The culms of *M. diffusa* Schreb., *M. neomexicana* Vasey, are much like those of the former species, only they are geniculate, and root freely at the nodes.

From those which are geniculate and rooting at the nodes, it is only a step to those which bear rootstocks on or below the surface of the ground.

M. comata Benth., produces branching rootstocks about five mm. long by one mm. in diameter. These are covered with thin bracts rather loosely appressed, and from one to two mm. long. They represent the sheaths of leaves only.

M. glomerata Trin., has rootstocks much like those of *M. comata*, only the internodes are a little shorter and the appressed scales more abruptly pointed. *M. willdenovii* Trin., has rootstocks which are rather larger, with internodes still shorter ($1\frac{1}{2}$ mm.), the scales broad, appressed, and more abruptly pointed than either of the previous species of *Muhlenbergia.*

The scales of *M. mexicana* Trin., are rather short, and bend abruptly away from the rootstock. The scales of *M. sylvatica* (T. and G.), are much like those of the former species. — *W. J. Beal, Agricultural College, Mich.*

Effect of Ice Upon Trees. — In the latter part of March of the present year a heavy fall of freezing rain covered the trees of eastern Nebraska with a coating varying from one-third to one-half an inch in thickness. Every twig, every bud was encased in a thick, transparent, icy envelope, whose weight bent and broke a great number of branches from the trees. There was a notable difference in the behavior of the different trees under this weight of ice. Trees with branches standing approximately at right angles with their axes fared best, while those with more upright branches were greatly mutilated. Thus the cottonwoods (*Populus monilifera* Aiton) suffered far less than their near relative, the Lombardy poplar (*Populus dilatata* Ait.). In the former, the widely spreading branches drooped over under the weight, and often became quite pendent, or even touched the ground without breaking, while in the last species the upright branches snapped off long before they reached a position sufficiently pendent to be stable. In the Cottonwood the branches had to bend through an arc of almost 90°, while in the Lombardy poplar the arc was increased to fully 135°. As a consequence the trees of the latter species were frequently almost entirely stripped of their branches, their stems remaining as nearly bare poles. On comparing different trees of the cottonwood, it was plain that those approaching the *excurrent* type of ramification suffered least. Some trees of this type were

PLATE IV.

Fig. 1. Rootstocks of *Leersia virginica* Willd., $\times$ about $1\frac{1}{3}$.
Fig. 2. Enlarged drawings of portions of separate rootstocks of *Leersia virginica* Willd., to show details as to the scales.
Fig. 3. Rootstocks of *Leersia oryzoides* Swartz, about $\frac{1}{2}$ natural size.
Fig. 4. *Muhlenbergia debilis* Trin., $\times$ about $1\frac{1}{3}$.
Fig. 5. *Muhlenbergia diffusa* Schreber, $\times$ about $1\frac{1}{3}$.
Fig. 6. *Muhlenbergia comata* Benth., $\times$ about $1\frac{1}{3}$.
Fig. 7. *Muhlenbergia glomerata* Trin., $\times$ about $1\frac{1}{3}$.
Fig. 8. *Muhlenbergia willdenovii* Trin., $\times$ about $1\frac{1}{3}$.
Fig. 9. *Muhlenbergia mexicana* Trin., $\times$ about $1\frac{1}{3}$.

scarcely injured at all, while those with a more *deliquescent* branching suffered the loss of nearly all their branches.

Elms usually bent their branches until supported on the ground. Maples (*Acer dasycarpum* Ehrh.) acted very nearly as the Cottonwoods did, some breaking, while others withstood the strain. No hackberries (*Celtis occidentalis* L.) broke at all, their strong branches with axillary angles of nearly 90° rendering them strong enough to withstand the heaviest weight.

White pines (*Pinus strobus* L.) suffered more than the Scotch and Austrian pines, the latter having (when young) more widely divergent branches than the former. Red Cedars and Balsam Firs trailed their lower branches upon the ground, while those above hung and rested upon those below.

An attempt was made to estimate the weight borne by each tree, and the result showed that such ice burdens are very generally overestimated. By melting the ice from a measured length of a twig, it was easy to estimate the amount of water carried by the tree. It was found that for a fine box elder, twenty-five feet in height, and with a large rounded top fully twenty-five feet in diameter, the total weight did not exceed three hundred pounds. The calculation was carefully revised, because the result seemed too small, but it was found to be correct. The effects which are so striking are clearly due to the fact that this weight, although so small, is borne as well by the slender twigs as by the larger branches. A weight of a few ounces upon the end of a long twig produces a much greater bending than many pounds would at its base.—*Charles E. Bessey.*

ZOOLOGY.

Sponges and Cœlenterates of Australia.—Dr. R. von Lendenfeld has published a résumé of the facies of the Australian Cœlenterate fauna (*Biol. Centralbl.*, Jan. 1, 1888). Australia is especially rich in sponges, containing no less than seventy per cent. of the known species of horn-sponges, Chalinas and Desmacions. Of the two first-mentioned groups, five hundred and seventy-five species and varieties have been described from all parts of the world; and of these, no less than four hundred and fourteen have been recognized in Australian waters. At least forty or fifty per cent. of the horn-sponges of any other region may be found in Australia; and this is not limited by distance or any other barrier. But the Australian horn-sponge fauna is most nearly related to those of Atlantic North America and of East Africa, the fauna of the Northern Indian Ocean differing more from that of Australia than does that of our own coast. Dr. von Lendenfeld regards the Monoxonous Tethyoid sponges as derivations of the Tetraxonia,

and says that in Australia almost all of the Tetraxonia have developed into the Tethyoid type. He does not agree with Ridley and Dendy in their views of the origin of the horn-sponges, but regards this group as having a polyphylitic origin. The Australian Calc-sponge fauna is very rich, while the deep-sea Hexactinellidæ and Lithistidæ are wanting.

His conclusions regarding the sponges are:—(1) The littoral sponges are widely distributed, about half the species being cosmopolitan; (2) The most recent and most highly-developed forms rarely occur in the colder waters, and their relative numbers is in proportion to the coldness of the sea; (3) Newer forms follow the older, not only when we go from the deeper to the more littoral zones, but from the poles to the tropics; (4) The lower and older types are more plenty in the cold than in the warmer seas, and are especially rare in Australia; (5) There are a series of forms which are confined to Australia, but there is only a few which are confined to any other region; (6) All the larger genera are cosmopolitan; (7) The fresh-water sponges are more uniform and more widely-distributed than are the marine sponges.

New England Medusæ.—Dr. J. W. Fewkes presents (*Bulletin Mus. Comp. Zool.*, xiii.) a list of the Medusæ which he has studied on the coasts of Maine and Grand Menan. The list embraces fifteen species and is illustrated by six plates. A full account is given of *Nanomia cara*, supplementing the account of Dr. Alexander Agassiz, showing that these forms really possess both sexes united in one colony, and giving an account of the embryos up to the eight-cell stage. The rare *Callinema ornata* is also figured and described. The most interesting form mentioned in the paper is a curious parasitic hydroid, for which a new genus and species (*Hydrichthys mirus*) is established, which was found at Newport, R. I. Attached to the side of a specimen of the fish *Seriola zonata* was found a colony of the hydroid, which, in captivity, gave off numbers of the medusa stage. The colony is attached to the fish by a leathery basal plate or hydrorhiza, much like that of Hydractinia. From this arise the branching, naked colony, with its numerous medusa-buds. The hydranths are without tentacles; and Dr. Fewkes thinks the hydroid a true parasite, taking its food by means of the anastomosing canals in the basal plate. Numbers of the medusæ were hatched which passed through a two-tentacled (Stomatoca) stage into one (Sarsia) with four tentacles, but it was not possible to rear them further. Dr. Fewkes compares this form with both the Tubularians and Velella. The relationship seems clearly to be with the former; and the similarities of the form to the Siphonophores are scarcely more evident than are those of any of the Hydromedusæ.

New Type of Hydroid Development.—Dr. W. K. Brooks, in the Johns Hopkins *Circular*, No. 63, describes a peculiar type of multiplication in a species of Oceania, studied in the Bahamas. Its hydroid larva is a small, abundant campanularian, which gives rise to a small medusa with eight marginal tentacles and four rudimentary radial reproductive organs. Some of these medusæ had, growing out from the reproductive organs into the cavity of the bell, true hydroid reproductive organs with chitinous cups (medusæ buds), and all exactly like those on true hydroid colonies. The blastostyles are peculiar, in that they differ from all other buds, in that this is a case of an adult budding larvæ [the abstractor adopts the views of Claus, Boehm, and Brooks as to the relationships of hydroid and medusæ], and that, while these buds have their ectoderm continuous with that of the parent, the entoderm is distinct and is seen to arise from the cells of the reproductive organs; and after these buds are formed, they are nourished at the expense of the reproductive cells of the medusæ. This type seems to be a peculiarly modified type of gemmation rather than an instance of sporogenesis, like that lately described by Metschinkoff in a species of Cunina.

Development of Brain Coral.—Mr. H. V. Wilson has studied the development of *Manicina areolata* (J. H. U. *Circular*, No. 63). The eggs are fertilized and undergo their early development in the body of the parent, beginning free life as solid planulæ, with beginning œsophageal invagination. The germ-layers are earlier formed by delamination, and now the endoderm begins to absorb the bottom of the œsophageal in-pushing and to form the permanent entoderm. The processes of formation of mesenteries and filaments is complicated, consisting in a pressing down of the entoderm and a successive application of the sides of the œsophagus to the ectoderm of the body in the various mesenterial planes. The filaments then arise as ectodermal lobes growing down along the body-wall from the inner extremity of the œsophagus. The entoderm later grows up under these, and thus arise all the mesenteries. The process of providing the incomplete mesenteries with filaments is more complex. The order of origin of the mesenteries differs from that of Lacaze Duthiers. The free life varies from a week to six or eight. They then settled down, and the basal ectoderm secreted a small calcareous plate. It was not possible to rear them beyond this point. Young polyps a quarter of an inch across had twelve septa developed; and it is noticeable that the edges of these were toothed, the teeth protruding through the external wall.

Mr. Wilson's observations go far to demonstrating the homologies between the Actinozoa and the Scyphistoma stage of Aurelia, as described by Götte.

Muscles of Molluscs.—There are frequently described in molluscs striated muscles, sometimes of a peculiar type. Müller and Keferstein have described them in the heart of Cephalopods and in the pharynx of the Cephalophora; Blanchard, in the adductors of Pecten, and Paneth, in the fins of Pteropods and Heteropoda. Schwalbe has described in the adductors of the lamellibranchs and elsewhere muscles with a double oblique striation, while, before him, Mettenheimer, Wagener and Margo had referred to the same appearance as spiral striation. Lately, Fol (*Comptes Rendus*, Jan. 23, 1888) has investigated the same subject, and concludes that true striated muscles do not exist in any mollusc. All cases reported as such, in reality, consist of smooth fibres, around which fine fibrils are rolled in a spiral manner, this being the case in all the special instances noted above. The method employed by Paneth (glycerine and nitric acid) produced such contraction that the spiral fibrillæ really appeared transverse. All of the molluscan muscles are of the smooth type; but these are to be grouped in two sub-divisions—that already mentioned, and that in which the fibrillæ are straight. The latter are the more abundant. Judging from their distribution, the spiral type are of value where a rapid contraction is needed.

The Primary Groups of Mail-cheeked Fishes. — A recent study of the structural characteristics of the mail-cheeked fishes has led to some interesting and unexpected results. The genus *Dactylopterus*, which has been almost universally closely associated in the same family with *Trigla* or *Peristedion*, and especially with the latter, was found to differ very widely. The relative proportions of the spinous and soft parts of the dorsal fin, to which so much value has been attributed by Dr. Günther, proves to be of comparatively slight importance. All the families recognized by Dr. Günther, except that of the Heterolepidotidæ, are very unnatural combinations of dissimilar groups; most of those recognized by myself are amply justified by anatomical evidence, but several others must be added to the list.

The genius of Cuvier, manifested in the perception of the relations of forms differing so much in superficial characteristics as do the mail-cheeked fishes, is justified by a detailed study of the various constituents of that group. The course of Günther and his followers in disintegrating it, widely divorcing its constituents, and associating its fragments with dissimilar forms, was a decidedly retrograde step. Nevertheless, although the group is one whose members are genetically connected, the diversities of structure are too great to allow of their retention in one family or even superfamily. They must be distributed into four (and ultimately more) superfamilies; those now determined are the Scorpænoidea, the Cottoidea, the Trigloidea, and the Dactylopteroidea. Several forms

that have not yet been anatomically investigated represent families—Caracanthidæ, Platycephalidæ, Agonidæ, and Rhamphocottidæ—exhibiting very peculiar characters, which must be reflected in their skeleton, and their exact relations remain to be ascertained; probably none belong to any of the superfamilies now established.[1]

The families hereinafter enumerated appear to be all well entitled to the rank, and are characterized by various anatomical peculiarities. The most closely allied pair, and which perhaps need future confirmation, are the Hexagrammidæ and Anoplopomidæ. All the families will be diagnosed and, in part, fully described in several memoirs prepared for publication in the Proceedings of the United States National Museum, and the anatomical characteristics of the crania will therein be illustrated. The comparative characteristics of the major groups, or superfamilies, are made known in the following analytical exhibit:

A. Scapular arch normal, the post-temporal and postero-temporal forming part, and the latter intervening between the post-temporal and the proscapula. Infraorbital chain with all bones entering into the orbital margin and functional, only partially extended over the cheek; with the third bone hypertrophied and developed as a stay impinging on the anterior wall of the preoperculum; post-temporal normally articulated with the epiotic and pterotic; intermaxillines with well-developed ascending pedicles gliding over the front of the prosethmoid.

1. Dentigerous epipharyngeals 3.3; actinosts moderate and inserted on posterior edges of hypercoracoid and hypocoracoid; ribs backwards borne on enlarged parapophyses.—*Scorpænoidea.*

2 Dentigerous epipharyngeals 1-1; actinosts large and partly intervening between the hypercoracoid and hypocoracoid; ribs sessile on the vertebræ.—*Cottoidea.*

B. Scapular arch abnormal, the post-temporal forming an integral part of the cranium and the postero-temporal crowded out of place by the side of the proscapula above or at the edge of the post-temporal.

1. Myodome (muscular tube) developed and cranial cavity open in front; prosethmoid and anteal normally connected by suture. Infraorbital chain with its anterior bones excluded from the orbit and functional as rostrolateral, the series covering the cheeks, the third a large buccal bone articulating with the anterior wall

[1] An examination of the *Platycephalidæ*, *Agonidæ* and *Rhamphocottidæ*, since the preparation of this note, has confirmed my suspicion that they are severally types of distinct superfamilies, *Platycephaloidea* (with families *Platycephalidæ* and *Hoplichthyidæ*), *Agonoidea*, and *Rhamphocottoidea*. I have been unable to secure specimens of *Caracanthidæ*, and know nothing of their anatomy.

of the preoperculum; post-temporal suturally connected with the epiotic and pterotic by inferior processes, and with the upper surface forming an integral part of the roof of the cranium; intermaxillines with the ascending pedicles atrophied and connected with the knob of the anteal (vomer) by ligament.—*Trigloidea.*

2. Myodome undeveloped, the cranial cavity being closed in front by expansions from the subtectals suturally connected with corresponding expansions of the prootics and the parasphenoid; prosethmoid and anteal entirely disconnected, leaving a capacious rostral chamber opening backwards mesially into the interorbital region. Infraorbital chain, with its second and third bones crowded out of the orbital margin by junction of the first and fourth, and leaving a wide interval between the suborbitals and the preoperculum; the first veiy long and extending backwards, the second under the fourth and the third developed as a small special bone (pontinal) bridging the interval between the second suborbital and the antero-inferior angle of the preoperculum; post-temporal suturally connected with the posterior bones of the cranium, and with the upper surface forming a large part of the roof of the cranium; intermaxillines with well-developed ascending pedicles gliding into the cavity between the anteal (vomer) and prosethmoid.—*Dactylopteroidea.*

The superfamily SCORPÆNOIDEA includes the families Scorpænidæ, Synanceidæ, Hexagrammidæ, (or Chiridæ), and Anoplopomidæ. The Caracanthidæ are generally associated with the Scorpænidæ and may belong to the superfamily, but this is doubtful.

The superfamily COTTOIDEA embraces the families Hemitripteridæ and Cottidæ.

The superfamily TRIGLOIDEA includes the families Triglidæ and Peristediidæ.

The superfamily DACTYLOPTEROIDEA is represented only by the family Dactylopteridæ.

It is probable that the Trigloidea and Dactylopteroidea will be hereafter segregated as representative of a peculiar suborder.—*Theo. Gill.*

THE COCOON OF PROTOPTERUS.—Professor Wiedersheim (Anat. Anzeiger) has collected together the various notices that have been written by J. E. Gray, A. D. Bartlett, Krauss, A. Günther, and others concerning the structure of the case or "cocoon" of the curious fish Protopterus, and describes the result of his own observations upon the subject. Krauss's description of the membrane surrounding the fish is substantially correct. It appears to be designed to protect the animal from damage during its æstivation;

but the source of the secretion composing it—whether the skin or a special apparatus—is not yet known. The manner in which the animal lies rolled up within its case is very singular and has not previously been described. The head and anterior part of the body are concealed or roofed over by the broad membrane of the lower lobe of the tail. Our author thinks it probable that the broad tail-fin serves the Protopterus for a purpose unheard of before, viz., as a breathing organ. The part which covers the head has a reddish tint, and it seems likely that it is permeable to air, even if we suppose it is in communication with the breathing-tube piercing the capsule.

A Grain-Eating Reptile.—Several lizards have been known to eat vegetable substances, among them *Uromastix acanthinus*, *Eumeces aldrovandi*, *Lacerta ocellata* and *Stellio vulgaris*. Johann von Fischer calls attention to the fact that *Uromastix hardwickii*, a Bengalese species in his possession, would take no animal food; but an examination of his excrement disclosed an abundance of starch granules. This led him to place before him various grains—rice, corn, etc.—which he ate with avidity. This is a new feature in reptilian diet. He also afterward ate various insects and drank—a fact which has not been witnessed in its relative, *U. acanthinus*. The chief food of the latter, lettuce, was neglected by the species in question, but it willingly ate straw and hay.

The Occurrence in Indiana of the Star-nosed Mole (*Condylura cristata* L.).—The star-nosed mole is rather generally distributed over northeastern North America. It is, apparently, common from Nova Scotia to New York and Pennsylvania, and Dr. C. Hart Merriam reports it as a "common animal along the outskirts of the Adirondacks, where it manifests a predilection for moist situations, being usually found in low ground and in the neighborhood of streams." West of New York and Pennsylvania, specimens had been taken by Dr. J. P. Kirtland at Cleveland, Ohio, and by Dr. J. F. Head at Fort Ripley, Minnesota, but only one specimen in the first and two in the second named State. In the Mississippi Valley, therefore, this interesting and curious mole would seem to be very rare. It therefore gives me pleasure to be able to report the capture of a specimen in this State. About the 5th of July last a fine adult male was obtained by Mr. J. C. Cunningham, near Denver, Miama county, Indiana. It was found lying dead near his door-step, where it had been dropped by the family cat, to whom belongs the honor of its capture. The specimen is now in my possession, through the kindness of Mr. Cunningham. This, so far as I know, is the first record of its capture in Indiana.—*B. W. Evermann*, Ind. State Normal School, Terre Haute, Ind.

ZOOLOGICAL NEWS.—ECHINODERMS.—The habitat of the star-fish, *Echinaster decanus* Müller und Troschel, has not been known. Lately it has been dredged of Port Jackson, Australia. Professor F. Jeffrey Bell, in an account of the specimens, states that the species is remarkable for the large size of the pore areas, in which there are a large number of respiratory processes, and hence concludes that it lives in situations where respiration under ordinary circumstances would be difficult.

The brothers Sarasin have a note on the longitudinal muscles and "Stewart's organs" in the Echinothuridæ, in the *Zool. Anzeiger*, No. 273. The long muscles are of use in the vermicular movements of Asthenosoma. Concerning the function of "Stewart's organs," they have no opinion to offer.

Fifty species of Echinoderms, twenty-two Holothurians, thirteen Asteroids, six Ophiuroids, and nine Echini, have been collected at the Andaman Islands by Mr. Booley.

WORMS.—Mr. F. E. Beddard continues his notes on the earth-worms. In the *Zool. Anzeiger*, No. 272, he states that the "mucous gland" described by Perrier in Urochæta "consists of a tube opening on to the exterior by a single orifice and branching distally into a number of tubules, each of which opens into the cœlom by a ciliated funnel," these funnels being disposed irregularly, and not metamerically.

In another note in the same number he describes briefly the salivary glands and capsulogenous glands in Perichæta. The former he regards as homologous of the septal glands of other Oligochætes. The capsulogenous glands, it is hoped, will furnish good characters for the discrimination of the species of this difficult genus.

Dr. Frederick Tuckermann notes a specimen of *Tænia saginata* of unusual size. Only a portion of the worm was obtained, but this consisted of 711 segments, and measured 7.455 metres in length. Comparison with other specimens led to an estimate that the whole worm consisted of about 1060 joints, and a total length of 7.655 metres.

According to Mr. R. Moniez, the cysticercus of the Tenebrios does not belong to *Tænia nana*, but, as is proved by the length and the number of its hooks, to *Tænia microstoma*, a species parasitic within the mouse. *T. nana* and *T. murina* constitute two distinct species, and the latter develops in the intestine of the rat without an intermediate host.

ARACHNIDA.—Duges describes (*Bull. Soc. Zool. France*, 1888) a new species of mite, *Geckobia oblonga*, which occurs, parasitic, upon the lizard, *Scoleporus spinosus*. The species is noticeable for the elongate organs, of problematical functions, which arise on either side above the base of the rostrum. They have an appendicular

appearance, are united at their bases, and terminate, each, in a toothed pincer.

FISHES.—M. L. Vaillant has recently, in a note upon the comparative dimensions of young and adult examples of *Alopias vulpes*, remarked that the size of the young is, among fishes, influenced by that of the parent, which commences to reproduce before its growth is complete. A specimen of *A. vulpes*, taken at Cette, measured 4.70 metres in length, and the largest of four fœtuses contained within its oviduct had a length of $1\frac{1}{2}$ metres. On the other hand, a female fox-shark, 1.17 metres long, also contained fœtuses.

It is not always that collectors note down the colors of the specimens while still alive, and thus the small collection of fishes from the Society Islands and Paumotu, made by Lieut. M. Trigon, becomes of value through the sketches accompanying it. M. Vaillant draws attention, in some prefatory remarks, to the losses incurred by attaching metal tags to the specimens by means of copper or iron wire instead of by vegetable fibre. Galvanic action is set up, and the scales and bones of the fishes, as well as the wire itself, are destroyed or fall apart.

A recent number of the *Izvestia*, of the Russian Geographical Society, contains M. Nicolsky's sketch of the fishing on Lake Aral, which is a valuable contribution to the ichthyology of that lake and of the Lower Arnu-daria.

After two periods of three years, each separated by one year of abundance (1883), sardines have returned to the French coast in greater abundance than ever, precisely at the period when the Government was commencing to inquire into the scarcity of that valuable little fish. M. Pouchet gave, in the *Revue Scientifique*, (June 11, 1887), reasons why 1887 might be expected to be a good year. Investigation of the ovaries of sardines of various sizes has convinced M. Pouchet that the sardine spawns at any season of the year, but always far from the coast, in other latitudes, or in inaccessible depths. The youngest sardines which visit the French coast are three or four months old, while those which are preserved in oil are about one year old and have not yet spawned. The sardine first spawns in the second year of its life.

Mr. and Mrs. C. H. Eigenmann catalogue the American species of Gobiidæ and Callionymidæ in the *Proceedings California Academy*, 1888. They enumerate seventy species belonging to the first, and four to the second, family. The new species are: *Gobius lucretiæ*, *G. garmani*, *G. hemigymnus*, *Microgobius eulepis*, *Barbulifer* (n. g.) *papillosus*, and *Callionymus calliurus*. A new genus, Clevelandia, is made for *Gobiosoma longipinnis*.

G. B. Howe (*P. Z. S.*, London, 1887), discusses the skeleton of the paired fins of Ceratodus, with observations upon those of the Elasmobranchs. His conclusions are that the characters of the

skeleton of the paired fins are inconstant, some of those of the praxial parameres of the pectorals and the basal mesomere of pectorals and pelvic fins; that a reduced metapterygrum is always present in the pectorals, and may occasionally be traced in the ventrals; and that the basal mesomere of the Ceratodus fin may conceivably have been derived from the metapterygium. The structural features of both paired fins of the Chimæroids are identical, and characterized by the absence of a mesopterygium, and the paired fins of Plagiostomes and Dipnoans have probably arisen from a type of fin most nearly represented by that of the living Chimæroids.

Prof. T. J. Parker describes and figures, in the Proceedings of the Zoological Society of London, the skeleton, fins, heart, brain, etc., of *Carcharodon rondeletii*, from specimens taken near Dunedin, New Zealand. A peculiarity in external form, scarcely noticed previously, is the depression of the tail just in front of the caudal fin, so much so that the width is more than double the height. Prof. Parker believes that this flattening, present also in Lamna, gives a combination of horizontal with vertical tail-fin, useful as a means of enabling the fish to rise rapidly from great depths.

Mr. Francis Day has lately published a work on British and Irish Salmonidæ. He regards the different forms of non-migratory trout known as Brook trout, Lochleven trout, Crasspuill trout, Estuary trout, Orkney trout, Cornish trout, Great Lake trout, Gillaroo trout, and Swaledale trout, as varieties of one species, and all the species of char as identical with *Salmo salvelinus*.

Reptiles.—Mr. C. M. Woodford has recently returned from the Solomon Islands with a collection of over two hundred reptiles, which have been examined by Mr. G. A. Boulenger. The fact that this large collection contained but four new forms indicates that the reptilian fauna of these islands is pretty well known.

Mr. F. E. Beddard notes the presence of a peritoneal fold in the genus Monitor, separating the lungs from the abdominal viscera, and corresponding to a similar structure in the Crocodilia.

Mr. G. A. Boulenger describes a Leptodactylus, three species of Lygosoma, *Typhlops aluensis*, and the Batrachia *Hyla lutea* and *Batrachylodes vertebralis*, from a collection made in the Solomon Islands by Mr. C. M. Woodford.

Two lizards, *Varanus niloticus* and *Chameleon owenii*, and the snakes *Naia haje* and *Dendraspis angusticeps*, were collected by Mr. Johnston, at a height of 2000 feet on the Cameroons Mountains.

M. L. Vaillant (Bull. d. l. Soc. Philo. de Paris) has recently described a new species of land-tortoise (*Testulo yniphora*) from one of the Comoro Isles, or from an islet in their vicinity. The carapace of the largest specimen is about fifteen and a half inches long,

twelve and a half inches wide, and nearly a foot in height. There is a small nuchal plate, and the plastron terminates anteriorly in a long, upturned tapering projection.

BIRDS.—Mr. D. D. Daly, at a recent meeting of the Zoological Society of London, gave an account of the caves in Borneo, from which the edible birds' nests are obtained. Of these, fifteen are known in North Borneo. Most of these are in limestone in the interior, but two are near the coast, and occur in sandstone strata.

Mr. H. N. Ridley found a new species of tyrant-bird in his explorations of the island of Fernando Norohna. Mr. R. Bowlder Sharpe has described it, under the name *Elainea ridleyana.*

Mr. R. S. Wray has found in the wing of the adult ostrich a vestigial structure representing the distal phalanges of digit III. (*P. Z. S.*, 1887.)

Among the thirty-five species of birds collected by Mr. C. Woodford, in the Solomon Isles, is a new crow, described by Mr. Ogilvie Grant as *Macrocorax woodfordi.*

Mr. Bowdler Sharpe has described (*P. Z. S.*, 1887) seven new species of birds, from a collection made by Mr. L. Wray in the mountains of Perak, in the Malay Peninsula.

Mr. R. S. Wray contributes to the *Proceedings* of the Zoological Society of London (1887), an important paper upon the morphology of the wings of birds.

MAMMALIA.—Dr. Dubois describes a sixth species of Anomalurus, under the name *A. chrysophœnus*, in the *Bulletin Société Zoologique* for January. It is most nearly allied to *A. pelii* of Temminck, and comes from West Africa.

The collection of mammals recently made in the Solomon Islands by Mr. Woodford, consisted chiefly of bats. Nothing was before known of the cheiropterous fauna of these islands. The new forms are *Pteropus gradis* and *Nesanycteris woodfordi*, nov. gen. et sp. The length of the head and body of a skin of *P. gradis* was 325 m. m., of which the head measured seventy-four m. m.

ENTOMOLOGY.[1]

On the Synonymy of the Apple-Leaf Creaser, Ornix geminatella (Packard).—Having lately had occasion to study the Tineidæ infesting apple leaves in Illinois, I have been puzzled over the proper name of a common species which inhabits a tent-shaped mine on the under leaf-surface. It is the insect that Mr. A. E. Brunn has discussed[2] as *Ornix prunivorella* Chambers, but which I believe to be the same as Packard's *Lithocolletis geminatella.* The agreement of my specimens of the various stages of the insect, with the descriptions of these species as given by Packard, Chambers and Brunn, led to a careful examination of the literature treating of the two species, the results of which I briefly summarize below. The subject is more fully discussed in a paper to be published in the Fifteenth Report of the State Entomologist of Illinois.

The various stages of *Lithocolletis geminatella* were described and figured by Dr. Packard in 1869.[3] The description of the moth is rather brief, but the figure is excellent. The larva is said to be of a pale livid reddish color, with the head and cervical shield black; and to mine the leaves of apple and pear.

Two years later Chambers published[4] an article on the described species of Lithocolletis, in which he surmises that geminatella does not properly belong to this genus.

In the *Canadian Entomologist* for March, 1873, Mr. Chambers published a description of *Ornix prunivorella*, stating that the larva mines the leaves of the apple and wild cherry, and giving a brief account of its habits.

In an article on the Food-plants of the Tineina, published somewhat later,[5] Mr. Chambers mentions this species as feeding on wild cherry, but strangely enough omits it from the list of those feeding upon apple, although in connection with the original description he remarks that "the larva mines the leaves of apple trees." In this list *Lithocolletis geminatella* is not mentioned.

In 1882 Lord Walsingham published[6] some "Notes on the Tineidæ of North America." This paper was the result of a study

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Tineidæ Infesting Apple Trees at Ithaca. Sec'd Rept. Corn. Univ., Exp. Stat., p. 157.

[3] Guide to Study of Insects, p. 353; Plate viii., Fig. 15.

[4] Can. Ent., vol. iii., p. 133.

[5] Bull. U. S. Geol. Surv., vol. iii., p. 133.

[6] Trans. Am. Ent. Soc., vol. x., p. 194.

of several American collections of these moths, many of the specimens being types of American species. On page 194, in speaking of certain of these specimens, he says:—

"I think these may be *Ornix prunivorella* Chamb., although that author does not record that the larva of that species feeds on apple or pear. These specimens are not in good condition, and it is impossible in so difficult a genus as *Ornix* to be quite certain to what species they belong.

"They are the types of *Lithocolletis geminatella* Packard, according to the label attached to the second specimen, but they undoubtedly belong to the genus *Ornix*."

From the statement just quoted, that Chambers does not record the apple-feeding habits of *O. prunivorella* it seems evident that Lord Walsingham had been misled by the omission in the list of food-plants noted above.

As the leaves of this species are quite characteristic, I sent specimens to Dr. Packard with the request that he examine them to see if they were similar to the ones from which he bred *L. geminatella*. In reply he says: "I have examined the *Ornix prunivorella*—two larvæ—white, exactly of the size and shape of my geminatella, which I have not seen for nearly twenty years. Mine was a uniformly brown caterpillar, but the spots on prothoracic segment were not so distinct as appears in your specimen—yet in my figure I see they are represented. I suppose the alcohol brings out the tubercles more distinctly than in life. It may be safe to regard the two species as identical, since Chambers bred it from the apple. On turning to Emerton's original drawing I see the spots on the thorax are represented just as in your specimen. My description on the sketch says: 'Color pale livid reddish, suspended by a thread to the tree.' On the whole, then, I conclude that the larvæ you send are those I described as *L. geminatella*."

The difference in the colors of these larvæ may easily be accounted for on the supposition that Dr. Packard's specimen was immature, for, as Mr. Brunn has remarked, these larvæ are flesh-colored when young.

In the light of these observations I believe that I am justified in treating these supposed species as the same, and, as Dr. Packard's name has priority, in calling the insect *Ornix geminatella* (Pack.).—*Clarence M. Weed.*

CONTAGIOUS DISEASES OF INSECTS. — Professor Forbes, in his address as retiring president of the Cambridge Entomological Club,[1] discusses the present state of our knowledge concerning contagious insect diseases. The address contains a statement of so many facts that it is not possible to abstract it in a short space. It should be read by all interested in the biological side of entomology that

[1] Psyche, Vol. V., pp. 3-12.

have not occasion to keep track of the literature concerning the minute organisms that cause disease. A few of the more general points can be stated here. Contagious disease, wherever it has been traced to its origin, has proved to be the phenomenon of parasitism. This address is limited to a discussion of epidemics caused by Fungus or Protozoan parasites.

Of the Protozoan diseases of insects, *pebrin* of the silkworm is the best known example. There has been much discussion regarding the position of this parasite; but there can be no longer a reasonable doubt of its animal nature, or of its agreement in general characters with those forms now commonly included under the head *Sporozoa,* a parasitic subdivision of the Protozoa of which *Gregarina* is perhaps the best known type. The life history of this parasite is very simple, and may be thus briefly summarized.

The minute oval spores, colorless, highly refractile, homogeneous in appearance, 4 μ long by 2 μ wide, when swallowed with the food, penetrate in some way unexplained the cuticle of the alimentary canal, and, in the cells of the epithelium, open at one end and emit their contents, each in the form of an amœboid speck of protoplasm. This grows to a spherical body, and, by a process of internal segmentation common to the Sporozoa, is soon converted into a mass of spores, each like the original. These spores everywhere undergo a like development, and load all of the tissues with their products, slowly and gradually arresting all of the functions of life. Their vitality is temporary — Pasteur's experiments showing that they will not germinate five weeks after drying out — and the disease is consequently maintained only by virtue of its hereditary character.

Other forms of Microsporidia have been found in at least ten species of insects enumerated by Forbes.

Although pebrine, and presumably other diseases of this nature, can be conveyed to healthy insects by treating their food with the dejections of affected individuals, the economic application of these diseases is limited to artificial measures for developing and accelerating them wherever they may be found, and to the transfer of them from one species to another. For there is not the slightest probability that the Sporozoa can be artificially cultivated outside of the bodies of the animals that they infest.

The notable fungous diseases of insects are readily divisable into two principal groups: *Schizomycoses,* produced by Bacteria, and *Hyphomycoses,* due to Fungi that form a more or less evident mycelium of cylindrical threads (*Hyphomycetes and Pyrenomycetes*). These are roughly distinguishable in two important particulars: (1) The bacteria invade the body from within, by way of the alimentary canal; and the thread fungi penetrate from without through the skin or spiracles; (2) Death from a schizomycosis is followed by rapid decay, which soon reduces the tissues to a putrid

fluid; while after death from a hyphomycosis the often flaccid body hardens and mummifies without decay, usually swelling to more than its usual size, and frequently becoming covered with a flour-like efflorescence of spores or spore-like bodies.

These last characters distinguish the hyphomycoses from the *pébrine*, — the body mummifying in the latter, but shriveling at the same time and never covering itself with spores, unless with those of a common mould of *post mortem* development. Further, the *pébrine* mummy contains only the minute oval spores of the parasite, while that of a hyphomycosis contains either a mass of mycelial threads or large thick-walled, spherical spores, — the lasting spores of the *Entomophthora*, or, possibly, both spores and mycelium together.

Examples of Schizomycoses, diseases produced by bacteria, are *flacherie* of the silkworm and foul brood of bee larvæ. Among the hypomycoses are muscardine and the common house-fly fungus, *Empusa muscæ*. In fact, nine-tenths of the adult and larval insects found dead and stiff on fences, weeds, grass, etc., in ordinary collecting, are victims of these parasites.

THE PROGENITORS OF MYRIAPODS AND INSECTS. — Under this title Professor B. Grassi[1] discusses the classification of the Thysanura, describes several new species of *Lepisma*, gives an account of the anatomy of *Lepisma* and *Lepismina*, and discusses the musculature of Thysanura. The last topic is of especial interest at this time as bearing on the separation, proposed by Brauer, of insects into two groups of equivalent rank, the Apterygogenea and the Pterygogenea, the former group containing only the Thysanura, the latter, all other insects. Professor Grassi was unable to discover in the musculature of Thysanura any indication of the previous existence of wings, thus confirming Brauer's view that these insects were "originally wingless," instead of, as in the case of wingless forms in the higher orders, being descended from winged ancestors.

The longest article contained in the *Proceedings* of the Zoological Society of London, Part II., 1887, is by Mr. E. B. Poulton, and treats of the protective value of color and markings in insects. It contains the tabulated results of extensive experimental researches.

[1] Bull. Soc. Entomol. Ital. XIX. (1887), pp. 52-74.

EMBRYOLOGY.[1]

Rudiments of True Calcified Teeth in the Young of Ornithorhynchus.[2]—Mr. E. B. Poulton, in a brief communication to the Royal Society, announces the discovery of the germs of true calcified teeth in the young of the Duck-bill, of 8.3 centimetres in length. The sections had been prepared by Professor W. N. Parker for Dr. W. K. Parker, who very generously placed them at the disposal of Mr. Poulton, and also urged the latter to publish the account of his discovery, offering, in addition, still other materials, not only of Ornithorhynchus, but also of Echidna. Dr. Parker had laid the sections in question aside for a time (owing to the pressure of other work), to eventually make use of them for the purpose of studying the skull, when Mr. Poulton borrowed the preparations for the purpose of continuing his studies on epidermic structures—with the result announced; and under the circumstances his association with this discovery is, therefore, purely accidental;—yet every true naturalist will appreciate the rare generosity of spirit which Dr. Parker has shown in allowing the independent publication of the results.

Tooth-germs, or, rather, young not-yet-erupted teeth, were found in both jaws; and they were found in such a position as to indicate that they probably represent some part of the molar series in the higher mammals. Examining the sections from the front backwards, the first tooth appeared a little behind the anterior margin of the epithelial elevation, which seems to represent the developing horny plate, which, in the adult, is the functional representative of true calcified teeth. The teeth seem to form a tolerably straight line, extending internally to the horny plates, and passing considerably further backwards than the latter. Owing to imperfections in this part of some of the sections, the author could not determine the exact number of teeth with accuracy; but they appear to be five or six in number on each side. The most anterior tooth-germ is different in character from the others, and is apparently separated from them by an interval which is longer than in other cases. This anterior tooth is the most developed, and its apex extends so far towards the surface of the oral mucous membrane that it nearly touches the epithelium. It is a pointed cylindrical tooth, directed vertically downwards. The four or five posterior teeth are of uniform shape.

The structure of the enamel-cap is entirely normal, except that capillaries are present in the middle membrane (reticulum), intruding from without. The inner layer of long enamel-cells is very

[1] Edited by Prof. Jno. A. Ryder, University of Penna., Philadelphia.
[2] Proc. Royal Society. Vol. XLIII, 1888, No. 263, pp. 353-356.

distinct. No enamel is formed from them at this stage, except, probably, in the case of the most anterior tooth. The dentine-germ was found quite normal in appearance; the depressed, superiorly conical pulp-mass resembles that seen in other Mammalia, and, as in some other forms, this is to some extent embraced around the sides and below by the in-curved lower edges of the dome-shaped enamel organ, which, as in other forms, is superimposed upon the pulp. Dentinal tubules and odontoblasts can be made out in the vicinity of the apex of the pulp-mass.

There can be little doubt that these structures are characteristic mammalian teeth, as supposed by their discoverer. Hertwig's researches serve to show that mammalian teeth are probably in a more ancestral condition than any other organ possessed by the adult. They must have been derived at one time from Prototherian ancestors—and yet existing Prototheria were not known to possess them. Their occurrence in Ornithorhynchus, therefore, supplies the step just where it is wanted; and the fact that they are practically identical with the young teeth of higher mammals is a further indication of the ancestral nature of these structures; for other higher mammalian features represented in the Prototheria are profoundly modified in the latter.

Mr. Poulton, in conclusion, announces his intention of tracing the further fate of the teeth of Ornithorhynchus in later stages, for which purpose Dr. Parker has also placed additional materials at his disposal.

The Ectoblastic Origin of the Wolffian Duct in Chelonia.[1]—In a note with the above title, K. Mitsukuri, of Tokio, Japan, gives a short account of his researches upon the development of the segmental ducts of *Trionyx japonica* (Schleg.) and *Emys japonica* (Gray). The author has found stages which show that the Wolffian duct arises from cells proliferated from the ectoblast, just opposite the region of the intermediate cell-mass. As described by others in other forms, these ducts in Chelonians are found by Mitsukuri to develop from before backwards.

Origin of the Wolffian duct in Lacertilians.—Investigations upon the development of *Lacerta agilis, L. muralis,* and *L. viridis* by J. von Perenyi[2] confirms and extends his observations upon the ectoblastic origin of the segmental ducts in this and other forms. Interesting observations are also recorded by Perenyi in the above-cited note on the development of the amnion and allantois of Lacerta.

[1] Zoolog. Anzeiger, XI, 1888, No. 273, p. 111.
[2] Zoolog. Anzeiger, XI, 1888, No. 274, pp. 138-141.

THE ORIGIN OF THE MAMMÆ.[1]—In this note, W. Haacke figures and describes the temporary marsupium of Echidna, and reasserts his claim to the priority of the discovery of the oviparity of the Monotremata. The conclusion is reached that the glands subserving a mammary function in these creatures are developed from sudoriparous glands, while in other mammals the mammary organs have been developed from sebaceous glands. Two apparently carefully-drawn figures of this pouch are given, which disappears after the single ovum is hatched. This pouch is not to be confounded with that described by Gegenbaur and Owen as occurring in this animal.

PHYSIOLOGY.[2]

DOES THE VOLUME OF A MUSCLE CHANGE DURING ITS CONTRACTION?—It has long been a disputed point whether or not the bulk of a muscle alters during its contraction. As far back as the middle of the seventeenth century it was the subject of investigation by Glisson, Borelli, Swammerdam and others, but their methods allowed of errors so great as to make their results nearly worthless. The first to observe by a fairly trustworthy method that the volume of a muscle is slightly lessened during contraction was Erman, about 1812.

Erman's method consisted in placing the muscle in a cylinder filled with water, and, during contraction of the muscle, observing the level of the water in a narrow capillary tube connected with the vessel. With every stimulation of the muscle Erman noted a slight fall of the fluid in the capillary. Some time after this, Johannes Müller suggested that the sinking of the level observed by Erman was caused, not by the diminution in bulk of the muscle itself, but by the compression of the air in the spaces between the fibres. Erman's experiments were thereupon repeated by Marchand and Ed. Weber who eliminated this possible source of error by killing the animals under water. Nevertheless they still observed a fall of the water in the capillary, precisely as Erman had done before them.

In more recent times Kühne has reinvestigated the question, and employed a new method, dependent on the change in specific gravity which must result from any change in volume. By this method Kühne reached negative conclusions, for he could observe no sinking of the araometer when the muscle attached to it was thrown into tetanus.

[1] Biolog. Centralblatt, VIII, No. 1, 1888, pp. 8–16.

[2] This Department is edited by Prof. Wm. T. Sedgwick, Mass. Inst. of Technology, Boston, to whom communications, books for review etc., should be sent.

On the other hand, Valentin, by the use of the balance, observed an increase in weight of about $\frac{1}{1370}$ during tetanus.

Other observers have obtained results quite as contradictory, and it seems almost as if every investigator came to conclusions differing from those reached by his immediate predecessors. All the while, however, the balance of evidence has appeared to be on the side of those who claimed that there was a slight decrease in the volume of the contracting muscle. Most of the recent text-books state it as probable that there is this minute diminution in volume.

There has recently been published an important paper on the subject by Professor J. R. Ewald,[1] who has repeated, as closely as possible, the experiments of Erman, Marchand, Weber and Valentin. Ewald regards Erman's method as by far the most delicate, if conducted in the right way and under favorable conditions. He then suggests that Erman and his successors have erred in some critical respects in the course of their experimental work.

Ewald accordingly altered Erman's method in the following manner: Into a glass flask two platinum wires are melted just above the base, so that they are diametrically opposite, and reach some millimetres down into the vessel. On the outside they form small hooks upon which can be hung the wires leading to an induction machine. The glass stopper of the flask is hollow and ends in a tube which is drawn out so as to be capillary.

The animal is killed under water, and the muscle without the nerve freed from the body. The flask, stopper and capillary tube are then filled with water, the muscle being first dropped to the bottom of the flask, where it rests on the two electrodes. The water in the capillary tube is lowered to a level favorable for observation, and a microscope fitted with a micrometer ocular is placed in a horizontal position, in order to observe the meniscus in the capillary. The time necessary for the adjustment of apparatus, etc., takes about three minutes, from the death of the frog to the pressing of the button for the stimulation of the muscle. Ewald then declares with emphasis: "*In none of the numerous experiments performed could I detect the slightest wavering of the level.*"

Ewald gives some striking examples of the sensitiveness of this method. If the palm of the hand is brought near the tube while the level is being observed through the microscope the water is seen to sink with great swiftness, owing to the expansion of the glass. A drop of ether evaporated on the glass produces the reverse effect —the meniscus rapidly rises. If the strength of the current be increased so that bubbles of gas begin to be formed on the electrodes, it will then be seen whether a very slight increase of volume in the interior of the flask will perceptibly change the posi-

[1] Archiv (Pflüger's) für die gesammte Physiologie (1887), Bd. xli., S. 215.

tion of the meniscus in the capillary. Ewald did this, and with a duration of the current so short that the bubbles on the electrodes became just visible, he saw the meniscus bound across the whole field of vision. By calculations based on the bore of the capillary and the magnifying power of the microscope, he found that a loss of a ten-thousandth of a cubic millimeter could not have escaped notice.

The author used also a second method, somewhat similar to that employed by Kühne, and obtained the same decisive negative result. He next repeated the experiments of Valentin, which were based on the use of a very delicate balance. Here, too, he states that, with proper precautions for securing the accuracy of the apparatus, there is in no case the slightest movement of the pointer.

Ewald then gives an extended account of his repetition of the experiments of Erman, Marchand and Weber. He suggests a very probable source of error in the failure of those observers to fix the stopper firmly into the vessel used in the experiments. When this and other details were attended to, he found that he could detect with the microscope no change in the level of the meniscus in the capillary tube.

Ewald, then, has repeated the experiments of preceding observers, has devised several new methods of greater delicacy than any heretofore used, and has arrived always at the same conclusion—*that in no case does a muscle change in volume during contraction.* Moreover, he has shown in addition that there exist very probable sources of error in the methods used by those investigators who have obtained positive results. Under such circumstances we can. hardly refrain from considering the question as settled beyond reasonable doubt.—*E. O. Jordan* (*Boston*).

ORGANIZATION OF THE AMERICAN PHYSIOLOGICAL SOCIETY —On the 30th of December last, about a score of the leading physiologists of the country met by appointment at the new College of Physicians and Surgeons in New York City, and proceeded to form an American physiological society. Dr. S. Weir Mitchell, of Philadelphia, was chosen temporary chairman, and Professor H. P. Bowditch, of Boston, clerk. A constitution was adopted and a formal meeting, the first of the American Physiological Society, followed. Officers were chosen as follows: *President*, H. P. Bowditch; *Secretary and Treasurer*, H. N. Martin, of Baltimore. These officers, together with Professors J. G. Curtis of New York, H. C. Wood of Philadelphia, and H. Sewall of Ann Arbor constitute the "Council" of the society. The constitution affirms that the society "is instituted to promote the advance of physiology, and to facilitate personal intercourse between American physiologists." The regular annual meetings are to be held, during the winter holidays,

at places fixed by the Council; and any resident of North America otherwise eligible (as described beyond) may be elected an Ordinary member. There were present, in fact, representatives from places as far apart as Montreal, Ann Arbor, Baltimore and Boston. The Institutions represented at the meeting included Harvard University, Yale University, Johns Hopkins University, The University of Pennsylvania, The University of Michigan, McGill University, The (Columbia) College of Physicians and Surgeons of New York, the Massachusetts Institute of Technology and the Medical Staff of the U. S. Navy.

The present members of the society are as follows: H. G. Beyer, U. S. Navy; H. P. Bowditch, Harvard University; H. C. Chapman, Philadelphia; R. H. Chittenden, Yale University; J. G. Curtis, New York; J. C. Dalton, New York; H. H. Donaldson, Baltimore; F. W. Ellis, Springfield, Mass.; G. L. Goodale, Harvard University; G. Stanley Hall, Baltimore; H. H. Hare, Philadelphia; W. H. Howell, Baltimore; Joseph Jastrow, Baltimore; W. P. Lombard, New York; H. N. Martin, Johns Hopkins University; T. W. Mills, Montreal; C. S. Minot, Harvard University; S. Weir Mitchell, Philadelphia; William Osler, Philadelphia; Isaac Ott, Easton, Pa.; E. T. Reichert, Philadelphia; W. T. Sedgwick, Boston; H. Sewall, Ann Arbor; R. Meade Smith, Philadelphia; V. C. Vaughan, Ann Arbor; J. W. Warren, Boston; William Welch, Baltimore; H. C. Wood, Philadelphia.

A Practical Definition of a Physiologist.—In the formation of any society it speedily becomes necessary to define its object and the qualifications requisite for membership in it. In the case of the new Physiological Society a general line of fitness was drawn (very wisely, as we believe) at investigation of some sort, as follows:—

"Any person who has conducted and published an original research . . . shall be eligible," etc.

Again, for practical purposes, "physiology" had to be defined; and it is very interesting to see that the physiology of to-day has so far advanced beyond the stage of merely "Human Physiology" that it was not deemed necessary to say at all that the physiology of plants (which the old system ignored) and that of the lower animals (which, for the most part, it disregarded) are genuine branches of the now broad and comprehensive science of the dynamics of living things. So, too, with experimental psychology. The time has gone by when physiologists need to explain that they welcome this as a vigorous and promising branch of physiology.

It appears, however, that with histology, pathology and experimental hygiene and therapeutics, the case is somewhat different; and the whole section relating to qualifications for membership read as follows:—

"Any person who has conducted and published an original research in Physiology or Histology (including Pathology and experimental Therapeutics and experimental research in Hygiene), or who has promoted and encouraged Physiological research, and who is a resident of North America, shall be eligible for elections as an ordinary member of the Society."

It will be observed that histologyoa subject almost purely morphological, is included (d oubtless frm its fundamental usefulness to the physiologist), while nothing is said of embryology, which, though largely physiological, has passed almost wholly into the hands of morphologists. The name "American," moreover, seems here better justified by the geographical limit adopted than is usual in the case of such organizations.

The Place of Bacteriology in Modern Science.—The preceding paragraphs may serve to show to which hemisphere of the great biological globe this new science belongs. For if bacteriology has a place anywhere, it is surely in experimental pathology and experimental hygiene.

Botanically speaking, bacteria are of no unusual interest on the morphological side. They are too small and too undifferentiated to yield great morphological harvests, at least with our present means of study. But from the physiological side they are just now without a parallel among living things, both in interest and in importance. The deeds which they do, the marvellous effects which they produce, are out of all proportion to their apparent anatomy. Some of the steps in the progress of this new physiological science will be hereafter noted in this department, and workers are cordially invited to send to its editor brief notes, or items of interesting news in bacteriology.

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

At the late meeting of the Society of Anthropology, Washington, D. C., interesting papers were read,—one by Mr. H. M. Reynolds on the subject of Algonquin metal-smiths. The writer treated with care the important question whether the Indians were acquainted with the art of smelting copper. He argued that the working of the copper-mines of Lake Superior was not of such high antiquity as has been supposed, and may have been continued until comparatively modern Indian times. The other paper was by Mr. Jeremiah Curtin, on Moqui myths.

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

Colonel F. A. Seeley, of the U. S. Patent Office of Washington, is interested in the various inventions of time-keeping, and has read a paper before the Anthropological Society in Washington on time-keeping in Greece and Rome. He is pursuing the subject, and invites correspondence and assistance. He proposes to trace the existence and development of the notion of time-keeping among savage and barbarous races; also the history of time-keeping from its dawn down to the middle ages.

SPURIOUS INDIAN ARROWHEADS.—An enterprising individual in the vicinity of Orwigsburg, Pa., has recently put on the market well-made arrowheads of curious design, against which it may be well to warn collectors. These relics, instead of being made directly from flakes, are genuine arrowheads *rechipped*, thus increasing the depth of the notches, sometimes the base of the shaft, and usually allowing so much of the lateral edges of the anterior portion of the arrowhead as to make it resemble at the point a small lozenge or diamond attached to the original base by a stem. One specimen which had been broken across was retouched, so as to permit the original base to remain, but presented two points, the intervening material having been removed. Another specimen was curved or lance-shaped, a fractured surface upon one edge having been rechipped. The new surfaces may be distinguished in most instances from the original; but, after having subjected the new relics to some process of polishing, they have been buried or otherwise coated with earth, so as to produce, as far as surface is concerned, every appearance of genuine Indian workmanship.

The object of the modern manufacture appears to be to furnish curious and unique forms, which are more saleable and command a higher price than the ordinary forms, the latter being common and of no great value.—*W. J. H. in the "American Anthropologist" for April.*

The National Geographic Society has been organized under excellent auspices. The Hon. Gardner C. Hubbard is President, and the membership amounts to two hundred.

Its fourth meeting, held 30th ult., was a symposium of geographers. Each scientist was allowed ten minutes in favor of his specialty, as a contribution to the formation of a complete atlas of physical geography. General Greely spoke for the climatic representation; Commander Bartlett, for the sea and its shore; Professor Ward, for Paleo-Botany; Dr. Merriam, the distribution of bird-life. Mr. Henshaw's subject was of greater interest to anthropology. He showed the distribution of Indian languages in North America at the dawn of its history. He presented a map made at the Bureau of Ethnology, the result of eleven years of labor of himself and Major Powell. This map covers the entire area of North

America, showing each Indian language belonging thereto, with all their sub-divisions, separations, and migrations—so far as possible to be discovered at this earliest epoch. This work is as interesting as it is important, and its authors are to be congratulated upon their success. It is to be hoped that Major Powell will have the map published for immediate distribution without awaiting the long tedium of the Public Printer, whose office is now being investigated by a committee of Congress.

The appointment of Mr. Justice Lamar to a seat upon the bench of the Supreme Court of the United States marks an era in the history of our country. Every one recognizes this as true politically; but I speak of it anthropologically. Mr. Justice Lamar is said to be what is called in French "*visuaire*"—that is, mental impressions are received upon his brain with greater facility through the eye than through the ear. One who receives these impressions best through the ear is called an "*auditaire*." The "visuaire" understands the thought best by *seeing* the printed page, while the "auditaire" receives his best impression by hearing. In the Supreme Court the arguments of counsel are, of course, oral; and how Mr. Justice Lamar, with this peculiarity of mental organization, will adapt himself to his new position remains to be seen.

These differences in human mental organization are well known to anthropologists. As some men can understand better when they see, and others when they hear, so some can think better when they speak than when they write; while others are the contrary. Governor Corwin of Ohio, was a notable illustration. Whether in the Senate, in the House of Representatives, at the bar, or on the stump, as an orator he was equalled by few and excelled by none. He thought well and clearly when on his feet. Amid all his wit and humor he was a most consummate logician, and could carry on the thread of an abstruse argument and support it by most cogent reasoning. But as Governor or cabinet officer, his state papers were not above the ordinary. Taking a pen in his hand, his thoughts seemed to scatter, and his writing was commonplace. Addressing the multitude, his thoughts seemed to crystallize into most beautiful forms, and he spake as one inspired. The causes of these differences have never been discovered. They are suggested as a theme for the student—biologist or anthropologist—as instructive as they are interesting.

"L'Homme Avant L'Histoire."—This is a new book on the subject of prehistoric man, written by M. Ch. Debierre, published in Paris. The author is a professor in the faculty of medicine at Lyons, France. M. Cartailhac, while giving it credit for much that is useful and interesting, criticises somewhat severely the mass of errors which he finds therein. Thus, page 141: "There are

stations where the debris of human work united the two ages (palæolithic and neolithic), and testify the passage from one to the other." M. Cartailhac says the author cites the cavern of Duruthy, but "that there is a superposition and not a juxtaposition between the two ages, and there is nothing to show the passage from one to the other. The sepulchral caves of Lozère are absolutely neolithic, and those of the Marne the same."

The author says "that at the end of the palæolithic age new races came from the east, invading the palæolithic people, and bringing with them a neolithic civilization." M. Cartailhac says "there is nothing to prove this."

Of the neolithic age the author says, "The reindeer was disappearing from the country (southern France)." He should have said, "had already disappeared."

Again, "some of the *dolmens* of France are known under the name of *menhirs*." He should have said, "some of the megaliths," etc.

"The men of the neolithic age immolated without doubt human victims to their gods," etc. M. Cartailhac asks "How do we know this?"

Again, "the similitude of the dolmens of India and Europe, like those of Europe *and America*," etc. M. Cartailhac says the last word should be Africa, for we do not know of true dolmens in America.

And, "it is nearly certain that the construction of dolmens was perpetuated in England and in France until near the eighth century of our era." M. Cartailhac says "this is a complete error."

L'HOMME (Man).—M. Gabriel de Mortillet, of Paris, is an active and versatile professor of the science of prehistoric anthropology. He was first a civil engineer, then geologist, assistant director of the Musèe St. Germain, mayor of that city, and now a deputy of France; but all the time ardently devoted to prehistoric anthropology, and the author of many valuable works. He devised the classification of Prehistoric man's occupation of France into epochs, giving to them a defined nomenclature which has been recognized by the country at large. He has been for many years the lecturer on this science before the School of Anthropology in Paris. He was the founder of the journal *Materiaux pour L'Histoire Primitive et Naturelle De L'Homme,* now conducted by Cartailhac and Chantre. In 1883 he established the journal *L'Homme*, which he has carried on with credit to himself and profit to his readers. He announces, with the close of the last year, the cessation of its publication. His assistants and coadjutors rank amongst the highest in their special sciences in France. They are as follows:—

Embryology and Biology, Mathias Duval; Physiology psychologic, Thulié; Comparative Anatomy, Georges Hervé; Archæology

prehistoric, Philippe Salmon; Ethnography and Craniology, Manouvrier; Sociology, Letourneau; Linguistic, Abel Hovelacque; Folk-lore, Paul Sébillot; Mythology, Girard de Rialle; Geography medical, Bordier; Demography, Mondière; Philosophy, André Lefèvre.

The cause of cessation of the journal is not from failure of any kind, but from greater devotion to science. These gentlemen, individually and collectively, are the founders and organizers of the *Bibliothique des Sciences Contemporaines*, of the *Dictionaire des Sciences Anthropologiques*, and of the *Bibliothique Anthropologique*, and they have decided to suspend the journal that they may devote their entire time to the two libraries and the dictionary.

The Prehistoric Anthropologists of the United States send their wishes of fraternal good fellowship.

The enquiry started by the Smithsonian Institution in regard to the existence and geographic distribution of the so-called "rude and unfinished implements of the palæolithic type," is one of high importance in the study of American Prehistoric Anthropology. Responses have been received from thirty States and Territories, the implements already noted amount to between six and seven thousand, and their distribution extends nearly all over the United States. Several hundred implements have been sent to the Institution, some of which do not belong to any palæolithic age, but many of them do. None seem to have been found in the mounds.

The implements themselves are of no merchantable value. The Institution desires them principally for verification, to see that they are really palæolithic implements, and not the leaf-shaped spear and arrow heads so common; also to know their geographic distribution. It wishes to know, approximately, how many have been found within a given district or State, if there has been anything peculiar in their finding, position or locality, especially with reference to river gravel drift.

The present examination is tentative and does not attempt to deal with the antiquity of this palæolithic age, but only to discover if there was such an age in America, and, if so, whether it had any extended existence. The attention of the average relic collector has never been called to this sort of specimen, and they have not usually been gathered. It will be something gained for science, to know how these implements are distributed over the United States, and especially their relationship to the glacial moraines.

MICROSCOPY.[1]

A NEW METHOD FOR THE MICROSCOPICAL STUDY OF THE BLOOD.[2]—The methods hitherto employed in preparing the blood for microscopical examination have aimed either at the production of *fresh* or of *dry* preparations. Preparations of the first class are not permanent, and those of the second class never exhibit the morphological elements intact. Dr. Biondi has worked out a method which combines the advantages, and is free from the defects, of previous methods. The problem was to find the means of perfect *fixation, preservation, imbedding,* and *mounting*—in other words, a method by which the blood could be treated as a solid tissue. The method is equally useful in the study of other organic fluids, and has been successfully employed in tracing the changes that take place in the maturation of the spermatozoa. It may doubtless be used to advantage in the study of Infusoria, as suggested by Biondi.

The point of chief interest in Biondi's method is the use of *agar* as an imbedding material. Agar is a vegetable gelatine, obtained from *Gracilaria lichenoides* and *Gigartina speciosa*, and has already been successfully employed for some time by Koch in bacteriological investigations. Among the different sorts of agar, the columnar form (Säulen-Agar) is considered the best. A perfectly transparent solution is required, in the preparation of which great care must be taken. This may be accomplished in the following manner: Place two parts of agar in 100 parts of distilled water, leaving it to soften for twenty-four hours at the ordinary room temperature; then heat to boiling on the sand-bath until the agar is all dissolved. The evaporation of the water may be checked by closing the flask with a cork provided with a long glass tube. Add carbonate of sodium to the point of weak alkaline reaction, and boil for an hour in a steam-apparatus. Pour the solution into long, slender test-tubes, and leave from twelve to twenty-four hours at a temperature of 50° to 60°C. The solution separates into two layers, the upper of which is quite clear, and this layer alone can be used for imbedding purposes. But clarification must be carried still farther before it is fit for use. The clear portion of the solution is next to be heated to about 40°, white of egg added, the mixture shaken up several times in the course of ten minutes, boiled for an hour in the steam-apparatus, and then

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee, Wis.

[2] D. Biondi. Neue Methode der mikroskopischen Untersuchung des Blutes. Arch. f. mik. Anat., xxxi., 1, p. 103, Dec., 1887.

filtered. The reaction should then be tested, and, if necessary, carbonate of sodium added until the solution is neutralized. Exact neutralization is necessary, in view of the staining fluid to be employed.

It is important that the mass should be kept sterile up to the moment of using, as otherwise a large number of micro-organisms may develop in it, and render it worthless for the finer uses. It is advisable, therefore, to keep the mass in test-tubes, limiting the quantity placed in each to the probable requirements of a single imbedding operation. For a single preparation of the blood five ccm. of the mass is sufficient. The test-tubes should be cleansed with hydrochloric acid and then washed with distilled water. After receiving the agar solution, the tubes are closed with cotton, and then sterilized in the steam-apparatus for half an hour daily on three successive days.

As the preparation of the agar mass is somewhat complicated, much time and trouble may be saved by turning this work over to some apothecary. König of Berlin (Dorotheenstrasse, 29) furnishes the mass prepared as above described.

The best medium of fixation for the elements of blood is a 2 per cent. solution of osmic acid. If a drop of blood from the frog be examined in this medium under the microscope, it will be seen that both the red and the white corpuscles are perfectly preserved in form and structure. The red corpuscles become a little paler than in the living condition, and are slightly browned. The corpuscles of mammalian blood are isolated and seen to greater advantage than in any other medium of fixation. As it is important that the acid should be perfectly clear and free from all impurities, it is well to filter before using.

Method of Procedure.—1. By the aid of a clean pipette, take a little blood from the heart of a frog, and allow two drops to fall into 5 ccm. of osmic acid (2 per cent.). Shake a little—the sooner the better—in order to separate the elements and scatter them through the whole body of the acid. After standing awhile, the blood corpuscles will be found at the bottom of the tube, the deeper layer being formed mainly of red corpuscles, which sink first by virtue of their greater specific gravity. Exposure, one to twenty-four hours.

2. The process of fixation completed, 4 to 5 drops of the mixture of blood and osmic acid are allowed to fall from a pipette into the melted agar, which is kept fluid at a temperature of 35° to 37°C. By rotating the test-tube, the blood corpuscles are distributed through the agar, and then the whole is poured into a paper box, as in the ordinary paraffine method of imbedding. Within a few minutes the mass stiffens, and may be removed from the box to 85 per cent. alcohol for hardening. In three to six

days the mass is hard enough for sectioning, and may be inclosed in elder pith and cut with the microtome.

If finer sections are required than can be obtained in this way, the agar block may be imbedded in paraffine in the following manner: The block is to be transferred from the 85 per cent. alcohol to bergamot oil (twenty-four hours), then direct to soft paraffine kept at a temperature of 45°C. After one to two hours, the imbedding process may be completed in the usual way. As the agar is saturated with paraffine, very fine sections may be obtained; and these may be freed from paraffine with the usual solvents, and then stained.

3. Sections thus prepared may be safely treated with nearly all staining media. Methyl green, methyl blue, fuchsin, safranin, etc., give the most reliable results. The agar itself is stained only by the most intense anilin dyes (*e.g.*, gentian violet), but in such cases it loses its color quickly in alcohol or in any other decoloring fluid.

4. Sections may be clarified, preparatory to mounting, in balsam or damar, in clove oil, origanum oil, bergamot oil, creosote, etc. Xylol alone should not be used, as it causes the sections to curl.

BOVERI'S METHOD OF PREPARING THE EGGS OF ASCARIS MEGALOCEPHALA.[1]—1. The egg-sacks are plunged for a few seconds into boiling absolute alcohol which contains 1 per cent. glacial acetic acid.[2] The eggs are thus killed instantly, and at the same time the egg-membrane is rendered penetrable to the reagents. The alcohol is allowed to cool gradually, and after a few hours the eggs are transferred to pure alcohol, colored, and examined in glycerine or clove oil. This method shows the achromatic spindles and the chromatic equatorial plates, but not a trace of protoplasmic asters.

2. The following mixture was used cold, with excellent results. A saturated solution of picric acid is diluted with twice its volume of water, and then 1 per cent. glacial acetic acid is added.

The egg-sacks are left at least twenty-four hours in this mixture, then washed in 70 per cent. alcohol, stained in Grenacher's alco-

[1] *Theodor Boveri.* Zellen-Studien. Jenaisch. Zeitschr., xxi., 3 and 4, p. 432, 1887.

[2] Van Gehuchten calls attention to the fact that acid alcohol was used by Prof. Carnoy long before Zacharias published his method. Carnoy employed the following mixtures:

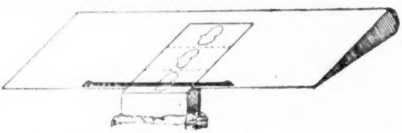
absolute alochol	6 vol.
acetic acid	1 vol.
chloroform	3 vol.

Chloroform renders the action of the reagent more rapid. *Vide*, La Cellule, t. III., f. 1, p. 6 and f. 2, p. 276.

holic borax-carmine (twenty-four hours), transferred to 70 per cent. alcohol plus 1 per cent. hydrochloric acid (twenty-four hours), and finally placed in pure alcohol.

For examination, glycerine is preferred to clove oil. If the egg-sacks are removed from alcohol to a mixture of glycerine (1 part) and absolute alcohol (3 parts), and then allowed to stand until the alcohol has evaporated, the eggs do not shrink. It will be found, however, that the eggs are not all equally well preserved with the cold mixture, owing probably to individual differences in the constitution of the membranes, some being more, others less, permeable to the fixing reagent.

An Inexpensive Section-smoother.—The cut shows a device for preventing the curling of paraffine sections, which is extremely



simple and easily made. After cutting off the head and point of an ordinary brass pin, fix it parallel to the edge of the knife by pressing its ends into two small pellets of beeswax. The proper elevation is easily determined by testing on the waste paraffine before the object is reached. The pin can only be used with the transverse knife. With the knife set obliquely, a piece of drawn wire will serve the same purpose.—*H. C. Bumpus.*

Tablets for Anatomical Preparations.—The following information respecting the materials used for mounting tablets in the Museum of Comparative Zoology has been furnished by Professor E. L. Mark:—

For dry objects, various materials have been used at different times: (1) Glass painted on one side; (2) plaster of Paris slabs, white or colored; (3) pasteboard; (4) wood, thin layers glued, with grain running at right angles; (5) slate; (6) cement. The last is worthless. Slate is now preferred.

Samuel Garman was the first to use the plaster tablets for alcoholic preparations. In the Annual Report of the Curator for 1877–8, p. 25, Mr. Garman says: "It is found that by mounting the majority of the Sauria and Batrachia on plaster tablets in jars of alcohol their value for purposes of exhibition is greatly enhanced. This takes considerable labor; but once mounted, they will need no further attention for a long period."

Garman used these tablets in his own room as early as 1875, but they were not introduced into the exhibition rooms until 1877.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

UNITED STATES NATIONAL ACADEMY OF SCIENCES. —The Academy met in Washington, commencing April 17th, 1888, and remained in session until April 20th, inclusive. The following papers were read:—"The Rotation of the Sun,"[1] J. E. Oliver; "The Foundations of Chemistry,"[1] T. Sterry Hunt; "On an Improved Form of Quadrant Electrometer, with Remarks upon its use,"[1] T. C. Mendenhall; "On the Vertebrate Fauna of the Puerco Series,"[1] E. D. Cope; "Reinforcement and Inhibition,"[1] H. P. Bowditch; "On Apparent Elasticity Produced in an Apparatus by the Pressure of the Atmosphere, and the Bearing of the Phenomenon Upon the Hypothesis of Potential Energy,"[3] A. Graham Bell; "The Orbits of Aerolites,"[3] H. A. Newton; "A Large Photographic Telescope,"[2] E. C. Pickering; "A New Method for the Biological Examination of Air, with a Description of an Aerobioscope,"[2] W. T. Sedgwick and G. R. Tucker (presented by J. S. Billings); "Preliminary Notice of the Object, Methods and Results of a Systematic Study of the Action of Definitely Related Chemical Compounds upon Animals,"[3] Wolcott Gibbs and Hobart Amory Hare; "On the Auditory Bones of the Batrachia,"[2] E. D. Cope; "The Orbit of Hyperion,"[2] Ormond Stone (presented by S. Newcomb); "Map of Connecticut River-Region in Massachusetts,"[4] B. K. Emerson (presented by J. W. Powell); "Parallel Series in the Evolution of Cephalopoda,"[2] A. Hyatt; "Evolution of Cephalopoda in the Fauna of the Lias,"[2] A. Hyatt; "The Evidence of the Fossil Plants as to the Age of the Potomac Formation,"[4] L. F. Ward (presented by J. W. Powell); "Vision and Energy,"[4] S. P. Langley; "Report of Progress in Spectrum Photography,"[3] H. A. Rowland; "Note on the Spectrum of Carbon and its Existence in the Sun,"[3] H. A. Rowland; "The Characteristics of the Orders and Sub-Orders of Fishes,"[4] Theo. Gill; "The Serpent-Mound and its Surroundings,"[4] F. W. Putnam; "The Systematic Relations of Platypsyllus as Determined by the Larva,"[4] C. V. Riley (presented by Theo. Gill); "On the Position of the Nova of 1572, as Determined by Tycho Brahe,"[4] C. H. F. Peters; "Some Notes on the Laramie Groups,"[4] J. S. Newberry; "On the Structure and Relations of Placoderm Fishes,"[4] J. S. Newberry.

Six new members of the Council were elected, as follows:—Professors Brush, Langley, Pickering, Remsen, Gould, and Gen. Meigs. Four new members of the Academy were elected—Profes-

[1] Read April 17. [2] Read April 18. [3] Read April 19. [4] Read April 20.

sors Michael and Michelson and Messrs. Chandler and G. B Goode. A rule was adopted which provides that the lists of papers of candidates for election to membership should be printed and circulated among the members, at least sixty days before the meeting of the Academy.

The Academy adjourned, to meet in New Haven in November next.

BIOLOGICAL SOCIETY OF WASHINGTON, March 24th, 1888.—The following communications were read:—Dr. Cooper Curtice, "*Tænia fimbriata*, a New Parasite of Sheep;" Mr. Charles Hallock, "Reversion of Domesticated Animals to a Wild State."

April 7th, 1888.—The following communications were read:—Captain J. W. Collins, "The Work of the Schooner Grampus in Fish Culture;" Mr. Chas. D. Walcott, "Cambrian Fossils from Mount Stephens, Northwest Territory of Canada;" Professor C. V. Riley, "Some Notes from Emin Pasha's Travels in Central Africa;" Dr. Theobald Smith, "The Destruction of Pathogenetic Bacteria in the Animal Organism."